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Economic Factors to Be Considered in the Selection of Machinery

By Paul M. Atkins

THE importance of the correct selection of machinery is a matter of such vital consequence to the welfare of the purchaser that it deserves thorough consideration.

Although the chief executives of many small-scale concerns have come from the manufacturing side of the business, often having begun by inventing the product and then fabricating it in large part themselves, it happens, nevertheless, that frequently they fail to make make a proper selection of equipment. Men who are unusually good mechanics are not always the best equipped to make decisions in regard to the choice of machinery, because they fail to consider other than the purely technical factors. It is of fundamental importance for the success of a small-scale enterprise that no serious mistakes be made in this matter. The cost of a single machine is relatively a more important factor in the expenditures of a small business than is that of a whole department of machines to some immense corporation. Moreover, the small industry is usually working upon a much narrower actual and potential financial margin than are the larger companies, and hence cannot afford to accept risks that may be avoided.

There are several steps to be taken in dealing with the selection of equipment. The first is to ascertain the needs it is expected to meet. This may seem at first glance a very simple problem for a manager familiar with the operation of his shops. A little further consideration will show that there is more to an analysis of this kind than appears at first glance. This is true even though it is a question of buying only one new machine. Every one knows the story of the man who found that it had been necessary for him to outfit himself from head to foot—hat, shirt, suit, overcoat, socks and shoes—all because he received as a Christmas present, a cravat that would not go with his other articles of clothing. The same result sometimes occurs in industry where the introduction of a single machine may necessitate the readjustment of all the machinery in the shop.

One of the first points to consider in the analysis of the needs for equipment, is whether the business belongs to the continuous process, the jobbing, or the intermittent type of industry. If it falls in the class of the continuous-process type, then the equipment will be used presumably for turning out only one kind of article. It is important under such circumstances, to select machinery that will be highly efficient in the production of this one product, for small gains per unit mean profits, and small losses mean a deficit at the end of the year. There is no necessity for any great degree of flexibility in the machinery chosen, unless there is serious probability that the form of the product will change. Other things being equal, the automatic type of machinery is the kind to choose in such a situation.

> Whether the product is standard or is liable to radical change; the quantity to be manufactured; the accuracy required; the types of machines on the market; whether the machines are to be driven by belt or motor; whether independent or group drive is to be employed; are some of the factors to be taken into consideration when determining what equipment will be the most economical in service and in lasting qualities

If the industry is of the jobbing variety—as are so many small machine shops—then the contrary situation exists. The manager has only a general idea of the kind of article he will be called upon to manufacture, and hence it is important that the equipment chosen be highly flexible—capable of performing a wide variety of operations—in order to allow its being used for all kinds of work. Moreover, great flexibility will permit an easier planning, scheduling and dispatching of work through the shop, because it will facilitate the constant operation of the shop.

The intermittent type of industry falls between these two, with a corresponding influence on the choice of machinery.

The stage of development of the product is another

factor that should be analyzed carefully. If the product is a new one the future of which is still quite unsettled, it is usually wise to select standardized machinery capable of performing a variety of operations. This holds true whether the product is so new that the possibilities of its market are only surmised, or whether the danger lies in changes of construction. Both of these conditions have much the same effect on the choice of equipment. It is rather expensive to write off the value of good machinery, due to obsolescence. An illustration of this whole question came to my attention in the case of an automobile manufacturer who had built some special machinery for boring all four cylinders of a four-cylinder motor at one operation. The next year "sixes" in his grade of car began to come into style and he was forced to follow suit. His special boring machinery had to be thrown out, however, for it was not sufficiently flexible to permit boring even four of the six cylinders of the motor block at one time.

On the other hand, there are many kinds of goods that have reached a relatively high degree of development and which will not, in all probability, be changed in any essential respect in the near future. Nails, screws, bolts, nuts, etc., are now standardized to a large extent and there seems to be no good reason for expecting a change in their standards. In such cases, specialized and automatic machinery may well be utilized in their production.

The probable future development of an article is a hard question to answer. To forecast the future in such a case, requires a careful study of the previous methods of production, an analysis of the probable future demand, and other factors peculiar to the particular case. In any event, it is an element that deserves consideration in connection with the selection of machinery.

What has been said about the future of the product applies equally well in the case of the future of the process employed. Is it likely to be suddenly changed, or has its development reached a stage of equilibrium? Such a question is very difficult to answer, but it should, at least, be envisaged when dealing with the major problem before us.

Adaptable Equipment

The character of the product must also be considered. Is it a staple article, or is it a novelty, the rage for the moment, to be forgotten the next? There are some goods the salability of which depends on their being new and different. In such cases, the equipment should be either highly flexible and easily adapted to other purposes, or else so inexpensive that there will be no hesitation about scrapping it, once the novelty of the article wears off. A manufacturer of novelties made by bending wire into a certain shape, was advised to discard his hand-operated wire-bending machine, and have automatic machines built to do the work. He replied that the sale of these particular goods might stop tomorrow, and the expensive machines be obsolete before they could be finished. That his present equipment could be adapted to bending wire into many different forms, and even if it had to be scrapped, his loss would be small, since the value of the machines had been absorbed in the cost of the product several times over.

The rate of output needed is another factor of importance in this analysis. Even in a small shop that presumably will have only a limited production, this problem cannot be wholly ignored. A machine capable of large output and low cost per unit when running constantly, may be a poor investment for a concern that can use it for only a portion of the time. A cheaper machine with smaller capacity may be much more nearly adapted to the needs of the company, and may give lower actual unit costs because it will be operated most of the time. This is simply an illustration of the point that idle machinery causes losses just as real as does paying wages to idle men. If such losses are spread over the product actually produced, it will frequently be found that the machine with the lesser output is the economical one for the small concern.

This question is intimately related to another which is frequently called the "integration of equipment." By this is meant the selection of machines in such a way that the rate of output of any one, or of any group, is substantially the same as that of any other machine or group of machines, through which work done on the first machine, or group, is likely to pass. If this balancing of equipment is not accomplished, so-called "bottle-necks" result. The "bottle-necks" are machines the capacity of which is not sufficiently great to allow work to pass through them as rapidly as through the rest of the shop.

Preventing Machine Idleness

This problem reaches an especially acute form in the case of continuous-process industries, for a single, "bottle-neck" can cause many other machines to lie idle, with the usual losses consequent upon idleness. In the jobbing type of industry "bottle-necks" are less dangerous, for it is possible to route work to other machines that are less efficient and desirable than the one on which the operation should logically be performed, and so prevent the shop from being tied up. It is evident, however, that it is necessary to analyze the capacity of machines already owned, and to choose machinery that will fit in with that already installed.

In the jobbing type of machine shop, especially the very small one, machines like the gap-lathe aid in finding a solution to the problem, for though less efficient than the standard lathe for any particular operation, such machines have a capacity for a wide range of work.

Another factor that demands analysis, is the degree of accuracy required in the fabrication of the product, as well as the quality of the merchandise desired. Hammers sold in the 5- and 10-cent store, for example, are castings, while the ordinary carpenter's hammer is a forging. The difference in the equipment required for the production of these two types of goods is apparent. There are many other cases where the answer is not so obvious, but the desirability of an analysis from this point of view exists in all cases. For some purposes, parts may be roughed out on a lathe, while in other instances they must be finished on a grinder.

The kind of labor supply available should also be considered. If only semi-skilled workers are to be had, it is impossible to use machines requiring highly trained machinists. One reason why the turret lathe is employed so extensively, is that it is such an efficient machine in the hands of semi-skilled workmen.

These are some of the factors to be considered in analyzing the needs for equipment. There are many others in certain cases, such as the kind of power available, if equipment requiring direct current, compressed air, gas, etc., is needed, or the weight of vibration of machinery, if the factory is located in a loft building where there is a limit on such things.

In any event, the manager should carefully analyze all factors from the standpoint of his particular concern. Having obtained all of the significant facts, he should next weigh them, for some are more important than others, their importance depending on the peculiar circumstances of the particular case. The essential point is to approach this matter in the scientific fashion that has just been outlined. When the data revealed by the analysis have been weighed, the manager is in a position to evaluate his needs for equipment, and he is placed in a position to know exactly what to seek. It is this kind of analysis that a big concern makes when it considers the buying of new equipment. The manager of a small company and his department managers are in a much better position to make such an analysis than is a big company that must use men unacquainted with the surrounding conditions when they start their investigations. The latter do have the advatnage, it is true, of specialized training in making an analysis and the time to devote to it. The manager of the small scale enterprise, however, could do this quite as well as they, if he were not so often inclined to rely on his general knowledge of the situation, and to "play his hunch," instead of analyzing the matter thoroughly. This lack of knowledge on his part also places him under a handicap in dealing with the salesmen of the machinery manufacturers, who know their own machines in great detail.

Determining the Type of Machine and Then Getting It

The second step is to study the available means of meeting the needs revealed by the analysis. This means, in brief, the consideration of the various types and makes of equipment on the market. If it is found as the result of this study that no suitable machine is available, then it becomes a question of designing and constructing equipment to meet the needs.

The analysis of the available machinery should be carried on in a scientific manner and the results should be recorded in a systematic fashion. Before a comparison can be made among the various machines, it is essential to reduce the data furnished by this analysis to a cost basis, for the latter is the only commensurable medium available for comparisons. The machine that is the most desirable is the one that will meet the needs at the lowest cost per unit of output.

Some of the factors that need to be considered in this connection are:

1—Weight of machine
2—Vibration
3—Kind of power required
4—Methods of holding work
5—Control of operation (hand controlled, semi-automatic, automatic)
6—Use of cooling fluids
7—Accessories required
8—Speed of moving parts
9—Safety of operation. (a) For operator. (b) For machine material
10—Rate of output
11—Speeds
12—Feeds
13—Adaptability to various kinds of work
14—Amount of space occupied
15—Kind of foundations required
16—Fire hazard involved
17—Integration with other equipment

Of course some of these factors may be eliminated and others added, depending on the nature of the machinery under consideration. A consideration of these factors must be translated into costs, some of the elements of which may be listed as follows:

1—First cost
2—Cost of installation
3—Rate of depreciation
4—Cost of accessories
5—Rate of consumption of accessories
6—Cost of repairs
7—Cost of power
8—Cost of lubrication
9—Cost of cooling fluids
10—Wage rate of worker
11—Cost of floor space occupied

All these costs must be reduced to an hourly basis and then to a cost per unit of output.

The reason for considering most of the above factors may be readily seen in most cases. The weight of the machine or its vibration when in use may limit its location to the ground floor, and this condition may eliminate certain machines because their choice would necessitate a complete rearrangement of the factory.

The kind of power required may in some cases be the controlling factor. Some of the machines may be equipped with pneumatic chucks, and if compressed air were used for no other purpose, the cost of its production for this equipment might be excessive.

If a piping system for cooling fluids has not been installed in the shop, and a machine under consideration requires cooling fluids for its satisfactory operation, it may be necessary to eliminate it from consideration.

Tools are another detail that deserve the most careful consideration. The effectiveness of a machine depends in large measure upon its tools, and their cost often represents a very important part of the cost of its operation. This is especially true if it is necessary to use special tools, for they cost much more than do standard tools. It is essential to make sure that the return from special tools will warrant the outlay to procure and maintain them.

All these various factors should be analyzed in detail in such a way as to facilitate their being translated into cost terms.

First Cost Not the Last

There are many other costs involved in the purchase or fabrication of machinery, other than its first cost. In the first place, there is the cost of installation, including the transportation charges from the place where it is made to the location where it is to be set up. Next, there is the cost of putting it in position and rigging it for use—the foundations on which it is to rest; the cost of the power transmission equipment needed to supply it with power; the cost of piping for cooling fluids; equipment for the removal of dust in the case of buffing and other similar operations; must all be considered as a part of the installation, and should be thought of in considering the desirability of selecting any particular machine, even though in some of them, the cost of power equipment, for example, may be charged to other accounts.

An important factor affecting the cost of utilization of a machine, is its rate of depreciation. The faster a machine wears out, the more rapidly must its first cost and the cost of its installation be written off, and hence the heavier is the cost of its use each year. In a large measure, the rate of depreciation depends on the care machinery receives, but to a certain extent it is influ-

enced by the type of machine chosen and the make of the machine selected.

The amount of power consumed varies not a little from machine to machine. While power usually does not cost much per horsepower, still this cost must not be overlooked. The cost of lubrication is another factor to be considered. Some machines are designed to be more economical than others in use of lubricants, and, with the increasing cost of these substances, this factor is becoming more important.

The type of worker needed to operate a machine and the wage which he must be paid, affect the cost of utilization of machinery. Machines that can be operated by semi-skilled workers offer an advantage in this respect. This feature is especially important in the small shop where the variety of work is likely to be relatively large, and if a machine can be operated satisfactorily by a man with relatively little training, it represents a distinct economy in use.

All of the various costs are relative. A machine may require a large amount of power, a skilled man to operate it, large quantities of cooling fluids, its first cost and its installation cost may be heavy and it may consume tools rapidly, and still it may be the most economical machine in the long run because of its large output. It is the cost per unit of output that counts. The small scale manufacturer must take care not to select a machine the capacity of which is too large for his factory. It has already been pointed out that unused machine capacity is a direct loss. This point is little appreciated and is so vitally important that it needs constant emphasis.

Above all, the selection of machinery demands detailed and careful analysis of the various factors involved—all of the factors. Especially, the needs should be thoroughly analyzed before any steps are taken toward making any selection. The small manufacturer in particular, cannot afford to make mistakes in a decision in this matter because of the far reaching effects.

Seen and Heard

By John R. Godfrey

The Halsey premium plan

It was many years ago that my good friend Fred Halsey hit upon his plan of modifying piecework in such a way that the boss didn't have heart failure every time one of the men turned out an extra large day's work. Halsey knew the weakness of straight piecework as it was practiced at that time, and devised a very ingenious way of making the boss see that the more the man earned, the more profit went into the till of the firm.

The average shop boss in those days couldn't see anything but the pay roll, and some bosses still have the same sort of astigmatic vision. The reduction of overhead by the increased output per machine was Greek to most of the old-time bosses. They only knew that when Bill Jones worked hard enough to double his wages, that he must have been loafing before, and they promptly cut the piece rate in two.

This didn't tend to promote good feeling, the men sulked if they didn't strike. Word went around the shop that it was only safe to earn from 30 to 50 per cent over day wages, and so the output was restricted.

In some shops men would keep a surplus of finished work tucked away under the bench against a day when they would fall below par, or material might be delayed, or there might be a hangover from a party in pre-Volstead days. They knew it wasn't safe to turn in too big a day's work as it meant a cut in the piece price.

So Halsey worked out his premium system of setting a price in hours instead of dollars, and splitting the saving between the men and the shop, usually on a fifty-fifty basis. The plan had a number of advantages, especially from the viewpoint of the boss. He didn't have to be as careful in setting the standard time, and he could see half the saving coming his way, whether he knew anything about overhead or not. From the men's point of view it had the great advantage of removing the ever present fear of a cut in piece rates. For one of Halsey's cardinal principles was, that the time should not be changed without the consent of the men.

As a matter of fact, there are some advocates of the premium plan who contend that the time set is of little importance, since the firm gains in any case. One enthusiast who has used the plan ever since it became public, claims that he has reduced costs by increasing the standard time since this method gives a greater incentive to the men.

In one particular instance, the time was so extremely liberal that the foreman and the men both agreed to cut it in half. In due course, the proposed cut came up to the manager who promptly vetoed it. He called in the foreman and the men and told them that the old standard time held as he had agreed and that there was to be no change from the time set.

It didn't take long for word of this to get around the shop and the manager told me, with a smile, that the shop saved 800 hr. that week as a result. The men had found out that the boss meant what he said and that they didn't have to hold back for fear of a change in rate. It was this point, more than all the others, that helped to put the Halsey plan over. And though we don't hear much about it nowadays, it is being used in more shops than we might suppose.

Following the Halsey premium plan, came a number of methods for accomplishing the same result, the Rowan of England being perhaps the nearest. This plan, however, is based on a scheme of diminishing returns, the worker getting a lower percentage of returns as his efforts increase. Opposite to this, and much more logical, was Taylor's differential piece rate, whereby the rate increased with the number of pieces.

Then there are bonus plans of various kinds, all with the object of securing greater output per unit of time. Many of them require a lot of bookkeeping and other paper work, so that some form of the Halsey premium plan seems to be the simplest and best for the average shop. In fact it can easily be adapted to almost any kind of work. It is easily understood, even by the unskilled worker, and offers a constant inducement for increased production. It was one of those happy thoughts that come mighty near, if not quite, being a stroke of genius.

Heat treatment covers a multitude of operations and there are few shops in which some of them do not find a place. For this reason every shop should have some man who is more or less familiar with handing steel. Unless some one takes a real interest in the job any shop is likely to be up against it some of these days.

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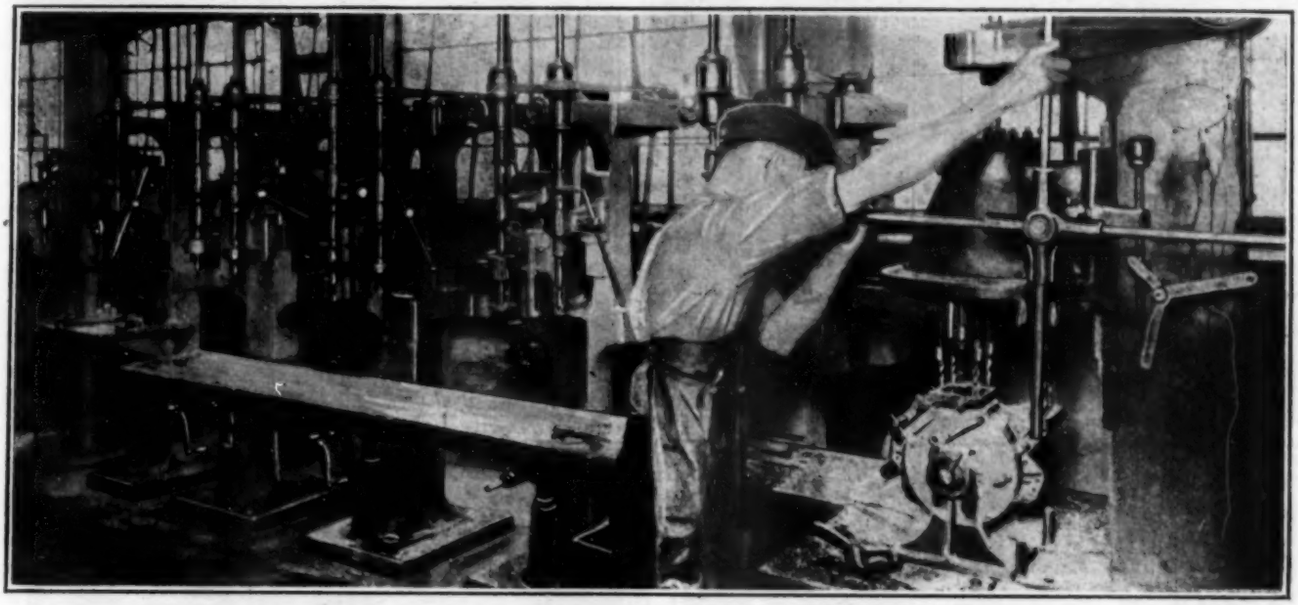

Good Tools Speed Motorcycles to Completion

By Frank W. Curtis
Western Editor, *American Machinist*

A selection of unusual machining operations, using special equipment and efficient tooling in producing miscellaneous motorcycle parts in the Harley-Davidson plant

MOTORCYCLES, nowadays, are made in quantities sufficient to warrant high-production manufacturing methods, and the Harley-Davidson Motor Co., Milwaukee, Wis., has built up a plant of well-devised production equipment, comprising both standard and special machinery, to handle the requirements of its production schedule. Accuracy in manufacture is required, since the parts must be interchangeable.

Parts, such as gear cases and covers, transmissions, cylinders and housings, that require a number of drilling operations are handled in jigs in which the majority of drilling can be done in one setting. Trunnion, indexing and turn-over jigs are used, being passed progressively from one machine to another while various operations are performed. The headpiece shows an example of an indexing jig in which the operator is drilling a twin-cylinder crankcase. One set of cylinder-pad holes and the magneto holes are being drilled, after which the jig will be indexed for drilling the holes in the second cylinder pad. The jig is then passed down the battery of smaller presses where additional drilling, tapping, counterboring, spotfacing and reaming operations are accomplished. In all, fifteen operations are completed in the set up. The machines are arranged close together, so that the cast-iron plates that are mounted on their tables form a continuous surface, enabling the jig to be slid easily from station to station. station.

Throughout the plant may be seen many special machines and attachments that have been designed to fulfill production requirements. Cages for transmission-case roller bearings are milled in the machine shown in Fig. 1. The steel blanks, produced in an automatic screw machine, are $1\frac{1}{8}$ in. in diameter, have $1\frac{7}{16}$-in. bore and are $\frac{7}{8}$ in. in width. Two pieces are

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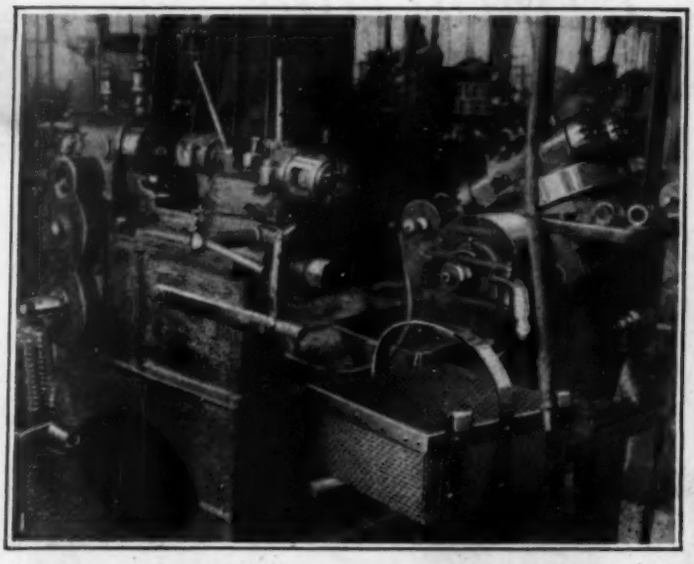

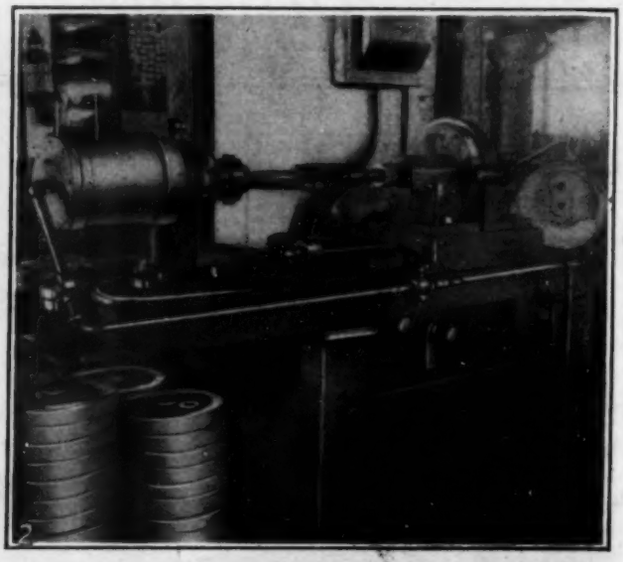

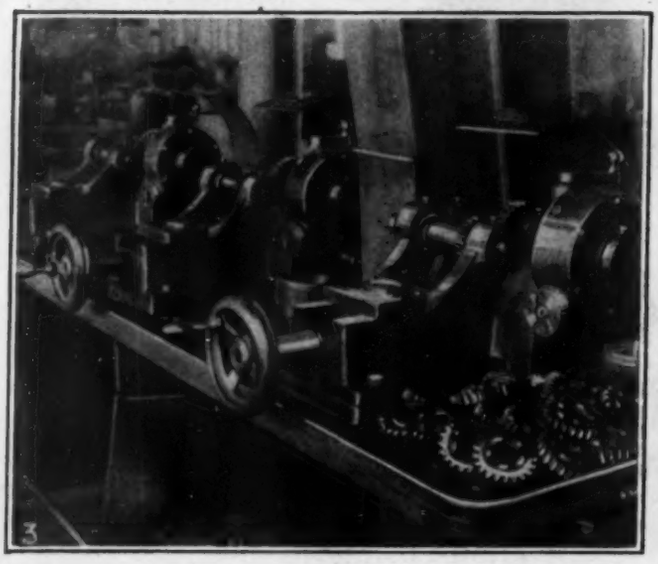

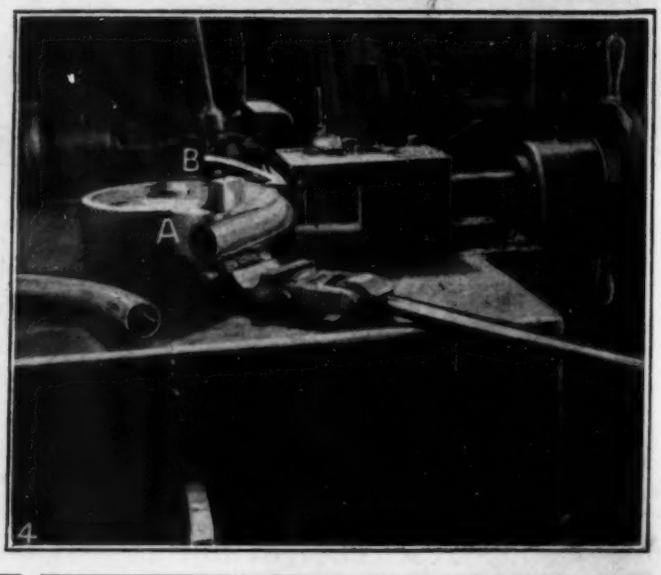

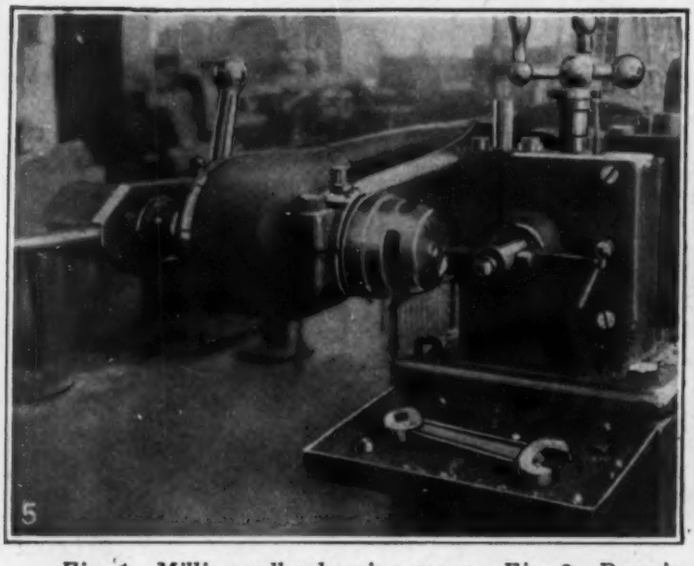

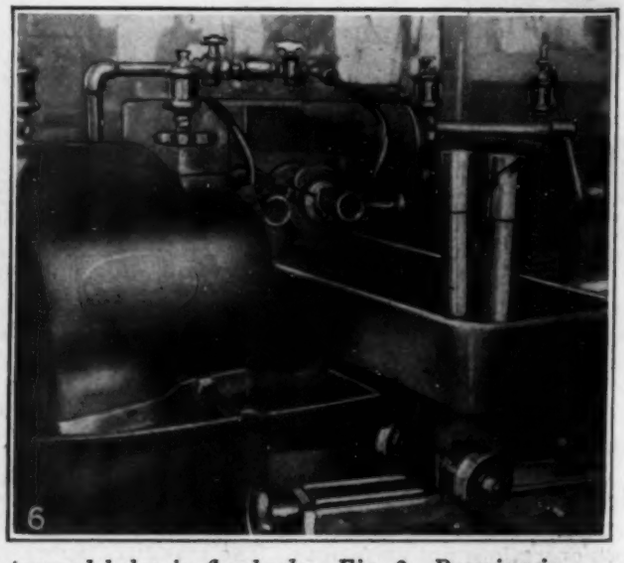

Fig. 1—Milling roller bearing cages. Fig. 2—Reaming tapered holes in flywheels. Fig. 3—Running-in transmission gears. Fig. 4—Bending an exhaust pipe. Fig. 5—Special lathe for small bushings Fig. 6—Machine used for cutting helical grooves

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held on each of the double-ended arbors in the revolving head shown at the right. The work is brought in line with two milling cutters. The cutters, mounted on a traveling head, cut single slots in each piece starting from the inside surface, so that the burr is thrown to the outside portion of the blank. While pieces at one end of the arbors are being operated upon, other pieces are loaded or unloaded at the opposite end. The head is indexed 180 deg. between operations.

On the left-hand side of the machine the work is end milled to form the seats for the rollers. A cluster of sixteen ¼-in. end mills, mounted in the head at the rear, is arranged to cut a radius on each side of each slot. The work is held in collets at opposite sides of an indexing head. After one piece has been milled, the head is indexed 180 deg. to bring the next piece in the cutting position. The head is mounted on a slide and is fed by hand. Oil is used as a lubricant for both cuts. One operator runs two sets of machines, each set being arranged to handle different sizes of blanks. From these machines the work is mounted on an arbor in gang form, and is ground on the outside to remove the burrs.

Flywheels have two tapered holes reamed in opposite directions in one setting on the special machine shown in Fig. 2. The center distance of the holes is held to a greater accuracy this way than by two handlings. The work is clamped with two hook bolts to a centrally located fixture. Reaming heads, positioned on opposite sides of the work, are driven through gears by a motor in the base. Air cylinders, operated at a pressure of 80 lb., are used for the feed. The holes are machined to a 7½-deg. taper, and the collar on the reamer bar is adjusted for controlling the depth of cut. The production averages 50 pieces per hour.

Transmission gears, after being machined, are revolved under pressure in mesh with a hardened mating gear, to remove the high spots and smooth out the tooth form, in the machine illustrated, in Fig. 3. The work is placed on an arbor fitting in a bracket on an adjustable slide. The slide is moved forward so the gear meshes tightly with its mate while it revolves at 60 r.p.m., a coating of machine oil having been first

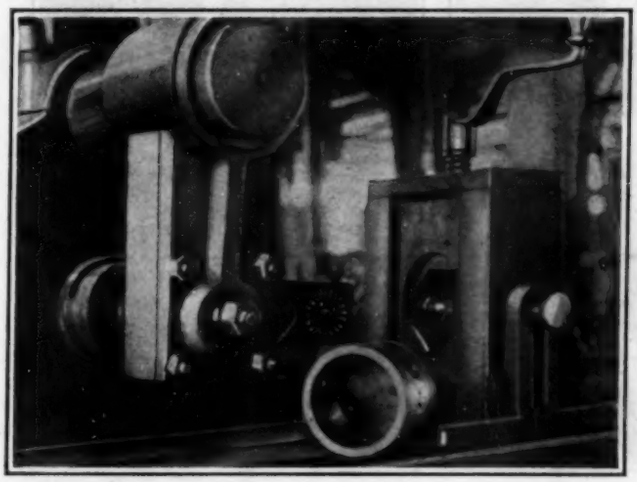

Fig. 7—Milling inside bosses of pistons

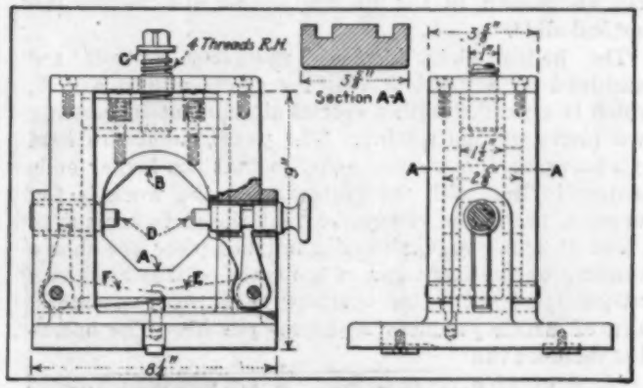

Fig. 8—Details of piston fixture

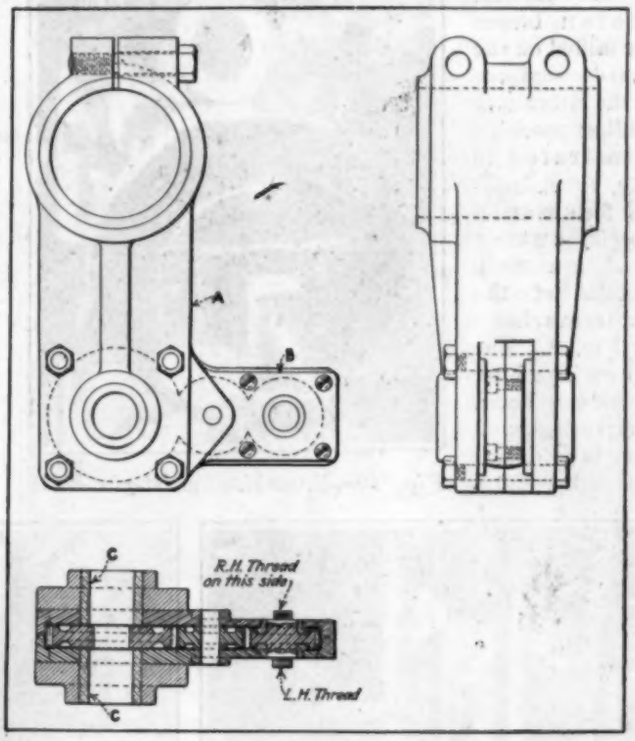

Fig. 9—Special milling head for pistons

applied. The average production is 100 gears per hour.

Exhaust pipes, 1¾ in. in diameter and of 20-gage seamless-steel tubing, are bent cold on the machine shown in Fig. 4. The pipe is placed on the former *A* and is held by the hinged clamp *B*. The adjustable form block, operated by a handwheel at the right, is set firmly against the tube. The former is then revolved by worm gearing, carrying the pipe past the block and forcing it to the shape of the former. The pipe shown in position in the former has just been completed.

Small brass bushings are machined on special machines, one of which is illustrated in Fig. 5. The vertical tool-slide is placed at the rear of the spindle, so that the work can be handled by the least movement on the part of the operator. A spring collet is used to hold the work. Some of the bushings machined on this

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tool are shown in the illustration on the top of the vertical slide.

The helical slots in the handle-bar controls are machined on a Pratt & Whitney spline miller, Fig. 6, which is arranged with a special attachment for cutting two pieces at one setting. The work pieces are held by chucks on the smaller ends, so that the larger ends project in line with the cutters. As the work is fed forward, the heads revolve so that the slots are cut to a lead of 3 in. A blank and a finished piece are shown standing on the front end of the table. Oil is used as a cutting lubricant. One operator runs three machines, each of which produces 20 pieces per hr. The operation includes the filing of the burrs produced by the cutters. Piston bosses are milled on the inside surfaces in the Milwaukee milling machine illustrated in Fig. 7. A holding fixture and a special cutter head are used. Details of the fixture are shown in Fig. 8. The work has been previously bored and turned, and for this operation it is located on the outside in floating V-blocks and through the wristpin hole by sliding locating plugs. The uprights of the fixture are provided with slots to receive the larger V-block *A*, the upper end of which is cut out to hold the smaller V-block *B*. As the clamping screw *C* is turned the smaller block is forced downward, lessening the size of the opening. The piston is located by the plugs *D*, both of which engage the holes simultaneously, their movement being controlled by the equalizing links *E* and *F*.

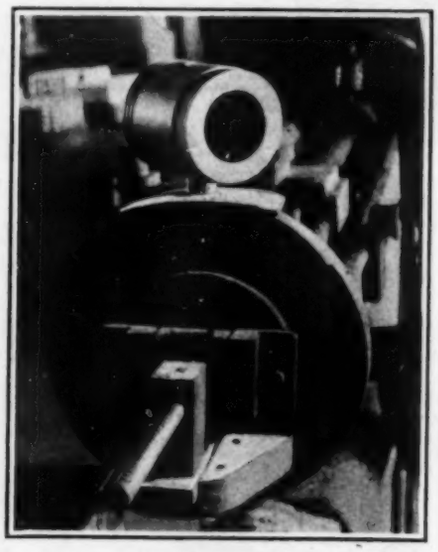


Fig. 10—Broaching wrist-pin holes

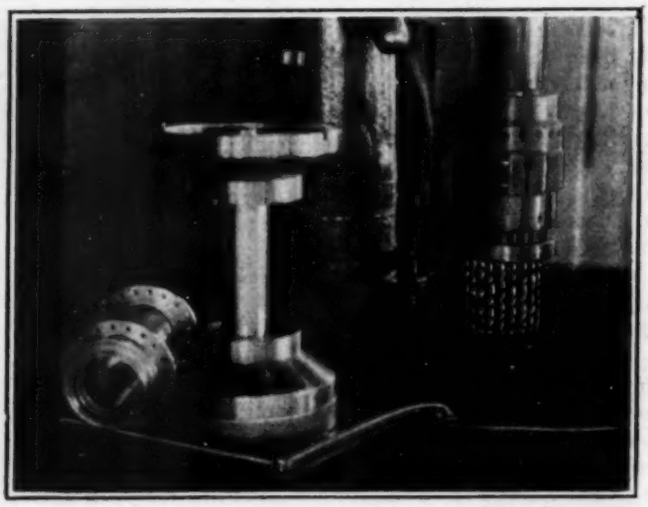
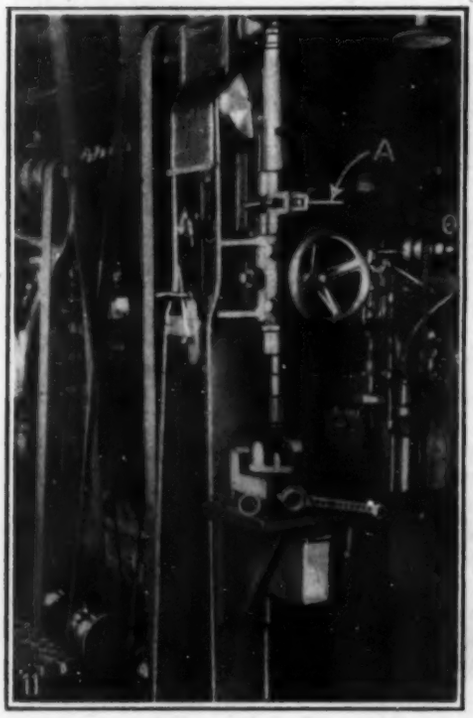
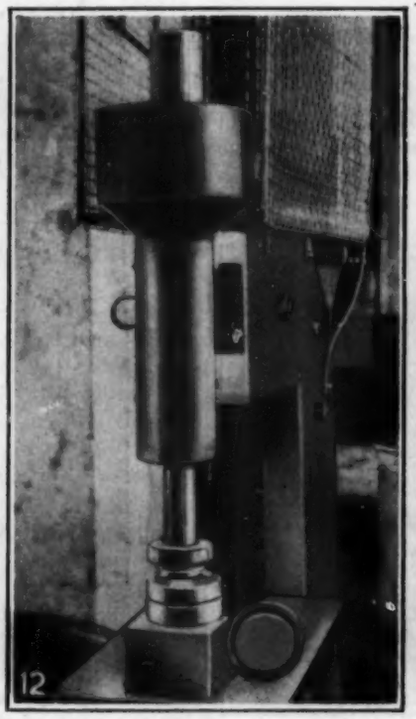


Fig. 14—Drilling spoke holes of rear hub

Details of the milling head, Fig. 9, show the method of driving the cutters for machining the bosses. The arm *A*, clamped to the overarm of the machine, is provided at the lower end with a machine-steel housing





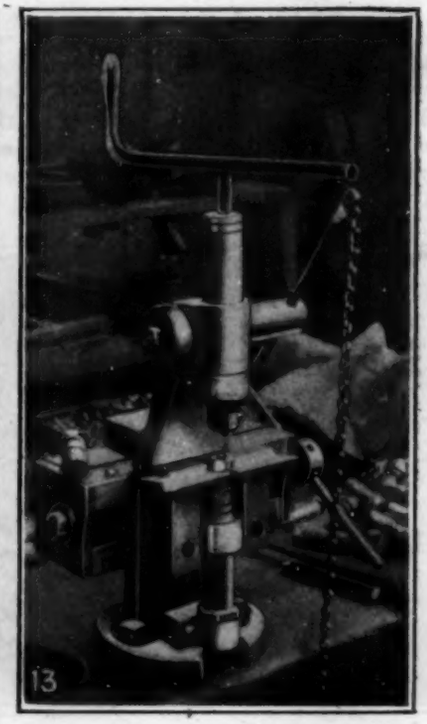


Fig. 11—Special lapping machine. Fig. 12—Running-in ball-bearing rings. Fig. 13—Device used for assembling the pump body

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B in which a set of three 16-pitch gears operate. The largest gear, having 56 teeth, meshes with an idler having 32 teeth, which in turn engages the 32-tooth driven gear. Side milling cutters, 2½ in. in diameter, are mounted on each side of the driven gear being held by left- and right-hand threads respectively. The arbor is provided with sleeves to fit the bushings *C* and a key to fit the driving gear.

Wrist-pin holes are broached to size on the Lapointe machine illustrated in Fig. 10. The fixture supports the work on the outside diameter by the formed plate in the rear, and on the opposite side by a block that fits against one of the inside bosses previously machined. Distortion is eliminated by supporting the piston on these two surfaces.

Connecting rods and miscellaneous bushings are lapped on the special machine shown in Fig. 11. The work is placed in a fixture on the adjustable table and the spindle is lowered to position the lap. The spindle is locked in the quill by two clamping lugs in the spindle slots, operated by the cam *A*. Operation of the machine causes the quill to work up and down as the spindle is revolved at 80 r.p.m. No. 180 abrasive dust and oil is used as the lapping compound. Approximately 0.0005 in. is removed from the bore of the work. Rods are lapped at the rate of 25 per hr. and bushings at 25 to 35 per hr., according to their size.

Ball races, after being machined, are rolled together in the converted riveting machine shown in Fig. 12. A ball-race assembly, including the balls, is placed on the block, so that the lower race is held stationary while the upper race revolves at 450 r.p.m. Pressure is applied by a treadle. Production averages 75 pieces per hr. The races do not require grinding after being hardened.

Oil-pump bodies are assembled as shown in Fig. 13, using a Johns chuck. The chuck is mounted on a base that locates the work for height, while the jaws grip the upper end of the pump body. A spring and a ball are assembled in

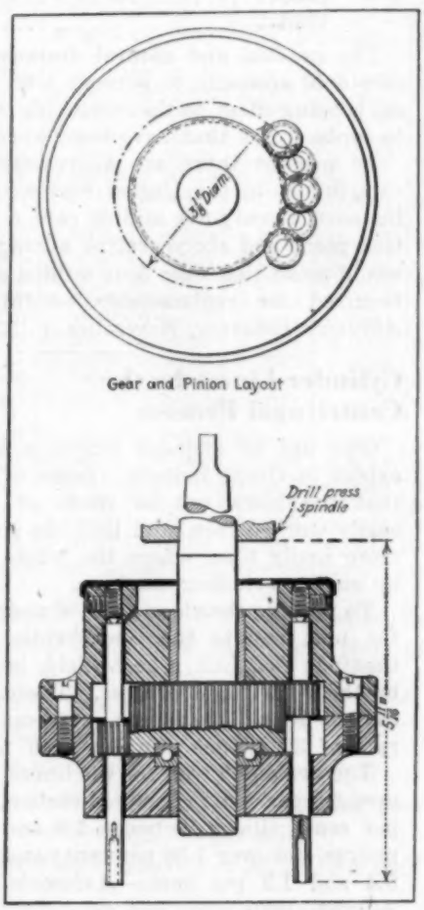

Fig. 15—Details of drilling head

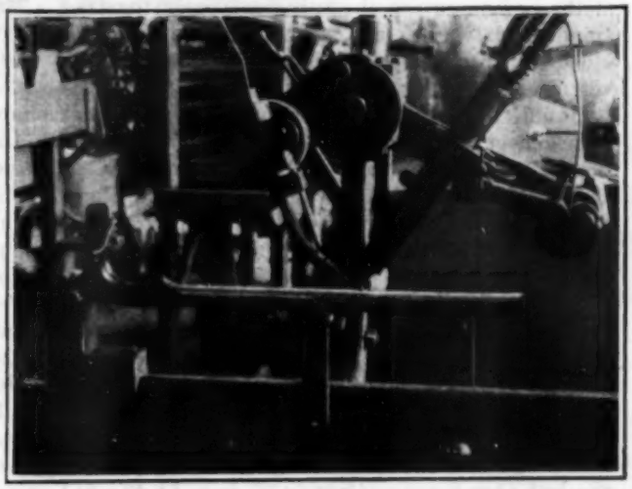

Fig. 16—Automatic welding machine for handle bars

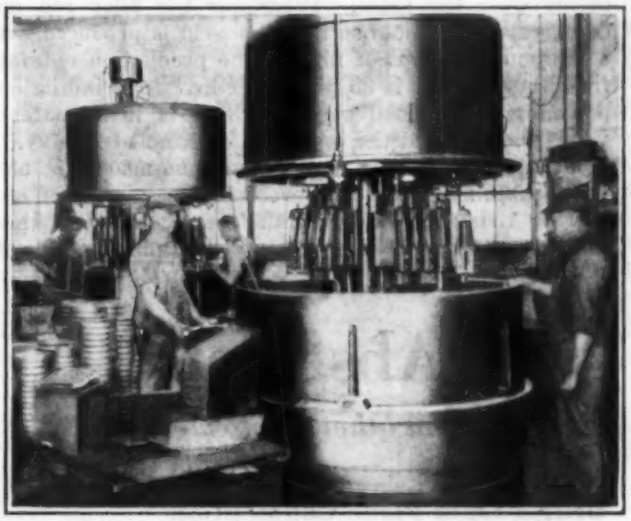

Fig. 17—Battery of Bullard mult-au-matics

the end of the body, then a headless screw is started by hand. A treadle brings the overhead screw-driver to the work and the operator revolves it by hand, driving the screw to the desired depth. A number of these chucks are used in connection with small drilling operations, since their design is suitable for handling odd-shaped work by using false jaws. Drill bushings are mounted on the stationary member when required. The chucks are rapid in operation and the chips are easily removed, since the front end of the chuck is open.

Rear-wheel hubs, after being finished on an automatic screw machine, are drilled for the spokes on a Cincinnati drill press, Fig. 14, in which twenty ⅜-in. holes, equally spaced in a 13½-in. circle are drilled. The jig, shown standing, is provided with bushing plates at each end. The unit is mounted on a stud that locates the jig radially by a key slot in line with the drill head and is submerged in a tank of soda water. When one side has been completed, the unit is reversed for drilling the other side. Constructional details of the drill head are shown in Fig. 15, which shows the

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method of mounting the spindles closely together. The spindles, driven by a 32-pitch, 52-tooth gear, are provided with 18-tooth pinions, so staggered in their vertical locations as not to interfere.

Handle bars are blanked and drawn to tubular shape from sheet stock, and then welded together at the seams. A home-made, automatic welding machine, shown in Fig. 16, is used for welding the seams. The work is located endwise and is clamped by its projecting portion against the V-block to be seen at the left-hand side. A support is provided for the outer end of the tube. The fixture is mounted on an automatically-fed carriage that is operated by an individual motor. Positioned over the work, is the stationary torch with hose leading to the oxygen and acetylene tanks. The filler rod, carried on a reel overhead, is fed through two rolls in an arm that is oscillated backward and forward by a cam in the base of the machine. Each stroke moves the rod ahead approximately ☆ in. As the rod comes in contact with the flame, it is melted and distributed evenly over the seam. Feeds for the filler rod and carriage are adjusted so that the weld is produced with a minimum amount of filler. The production obtained from the machine is 35 pieces per hr. In grinding and polishing the welded surface, there is little material to be removed and the operation is handled rapidly.

A battery of three Bullard mult-au-matics is used for machining flywheels, sprockets, large ends of connecting rods, and other similar parts. Two of these machines (Fig. 17) are set up for handling flywheels.

Abstracts

from other publications

British Light Plane Competition

Prizes offered principally by the *London Daily Mail* were the stimulus of a recent light plane competition at Lympne, England. The planes were judged on a basis of useful load carried per unit of fuel consumed during the contest period. The only limit to the airplane entered was that the completed engine must not weigh over 170 lb. Every engine entered was air-cooled. Planes had to be two-seaters with dual control, an air-speed indicator visible from each seat and each must be large enough for a person 6 ft. tall. A minimum useful load of 340 lb. was required.

The average daily flight was from 300 to 350 miles; the total 1,994 miles.

The winning plane was a Hawker "Cygnet" with a Bristol-Cherub engine. The plane weighed 420 lb. empty and 900 lb. loaded. The fuel used was 388.83 lb. and the average over-all speed 64.98 m.p.h. The second plane was of the same make, which used more fuel and was 9 m.p.h. slower. The first four planes all used the same engine, rated at 34 hp. Other contests were for planes with folding wings. The main object of the competition was to popularize the light, low-powered plane.—*Aviation*, Nov. 1, 1926, p. 742.

Flexible Exhaust for Multiple Cutters

Flexible pipe joints are being used to carry off shavings and dust from the multiple cutter heads of a special machine for broaching siderails for top frames in the plant of the Fisher Body Corporation, Detroit. This machine, operated by one man, completely broaches the siderail for the nine cross-rib sockets. Nine cutter heads are combined in the machine and are operated outward and upward against the top siderail.

Sheet-metal hoods are attached over each cutting head, and incline with the action of the machine. From the exhausting pipe a series of telescoping pipes with double acting swivel joints is dropped to each of the hoods. These freely moving pipes permit the hoods to swing with the action of the cutting heads and catch all refuse in every position during the broaching operation.—*Motor Vehicle Monthly*, September, 1926, p. 33.

Automobile Industry Is Prosperous

A study of car sales based upon new car registration during the last four years indicates real stability, but not that the saturation point has been reached. The figures for the four automobile sales years are as follows:

1923	2,823,000
1924	3,040,000
1925	2,935,000
1926	3,320,000

The gradual and natural decrease in the number of cars sold annually to persons who never before had a car is being offset by the increasing number of sales made to replace cars that have been worn out and discarded.

At present there are approximately twenty million cars in use in the United States and Canada. If, for instance, twenty-five million cars represents the saturation point and six years the average life of a car, this would mean that over four million cars a year would be required for replacements. — JOHN L. BASBROB, in *Abrasive Industry*, November, p. 337.

Cylinder Liners by the Centrifugal Process

The use of cylinder liners is being used to some extent in Great Britain. Some of the advantages are that the block can be made of a softer and more easily worked iron, and that the sleeves can be ground more easily than where the whole block has to be set up on the grinding machine.

To provide the close grained and uniform iron needed for best results the Sheepbridge Stokes Centrifugal Castings Co., Ltd., Chesterfield, is casting such sleeves by the centrifugal process. These liners are from 200 to 240 Brinell hardness, and can be machined at a rate of 30 ft. per min., or even faster in some cases.

The analysis given for the liners is: Total carbon, not over 3.5 per cent; combined carbon, between 0.45 and 0.8 per cent; silicon, between 1.8 and 2.5 per cent; phosphorus, not over 1.00 per cent; and manganese, between 0.4 and 1.2 per cent.—*Automobile Engineer*, p. 298, August, 1926.

Gear Teeth in Action

By Earle Buckingham

Associate Professor of Engineering Standards and Measurements
Massachusetts Institute of Technology

Determination of equivalent static load—Simplification of the equations by means of tabular data—Characteristics of non-metallic pinions—Typical gear problems

IN ALL equations for strength, the attempt is made to establish the working load in terms of an equivalent static load. From the incomplete data now available, it would appear that the following equations should be satisfactory for the determination of the strength of gear teeth, as derived in the preceding article:

$$L = \frac{efy_1y_2V^{\frac{1}{3}}}{(y_1+y_2)g\sqrt{p}\left(\frac{1}{E_1}+\frac{1}{E_2}\right)(V+1{,}200)} \qquad (5)$$

and

$$Ws = W + \sqrt{WL} \qquad (6)$$

Table VII—Absolute Tooth Errors in Inches Corresponding to Assumed Percentage Errors

D.P.	Circular Pitch, In. p	$\sqrt{p}$	Value of e when $\frac{e}{\sqrt{p}}$ equals						
			0.0005	0.0010	0.0020	0.0030	0.0040	0.0050	0.0060
1	3.1416	1.7724	0.00089	0.00177	0.0035	0.0053	0.0070	0.0089	0.0106
1½	2.5133	1.5853	0.00079	0.00159	0.0032	0.0048	0.0063	0.0079	0.0095
1½	2.0944	1.4472	0.00072	0.00145	0.0029	0.0043	0.0058	0.0072	0.0087
1¾	1.7952	1.3398	0.00067	0.00134	0.0027	0.0040	0.0054	0.0067	0.0080
2	1.5708	1.2533	0.00063	0.00125	0.0025	0.0037	0.0050	0.0063	0.0075
2¼	1.3963	1.1816	0.00059	0.00118	0.0024	0.0035	0.0047	0.0059	0.0071
2½	1.2566	1.1210	0.00056	0.00112	0.0022	0.0033	0.0045	0.0056	0.0067
3	1.0472	1.0233	0.00051	0.00102	0.0020	0.0031	0.0041	0.0051	0.0061
3½	0.8976	0.9421	0.00047	0.00094	0.0019	0.0028	0.0038	0.0047	0.0056
4	0.7854	0.8862	0.00044	0.00089	0.0018	0.0026	0.0035	0.0044	0.0053
5	0.6283	0.7927	0.00040	0.00079	0.0016	0.0024	0.0032	0.0040	0.0047
6	0.5236	0.7236	0.00036	0.00072	0.0014	0.0022	0.0029	0.0036	0.0043
7	0.4488	0.6699	0.00033	0.00067	0.0013	0.0020	0.0027	0.0033	0.0040
8	0.3927	0.6267	0.00031	0.00063	0.0013	0.0018	0.0025	0.0031	0.0037
9	0.3491	0.5908	0.00030	0.00059	0.0012	0.0017	0.0023	0.0030	0.0035
10	0.3142	0.5605	0.00028	0.00056	0.0011	0.0016	0.0022	0.0028	0.0033
12	0.2618	0.5117	0.00026	0.00051	0.0010	0.0015	0.0020	0.0026	0.0030
14	0.2244	0.4711	0.00024	0.00047	0.0009	0.0014	0.0019	0.0024	0.0028
16	0.1963	0.4431	0.00022	0.00044	0.0009	0.0013	0.0018	0.0022	0.0026
18	0.1745	0.4177	0.00021	0.00042	0.0008	0.0012	0.0017	0.0021	0.0025
20	0.1571	0.3963	0.00020	0.00040	0.0008	0.0012	0.0016	0.0020	0.0024
24	0.1309	0.3618	0.00018	0.00036	0.0007	0.0011	0.0014	0.0018	0.0021

Where L = increment load when W and L are equal, lb.
e = maximum combined error of pair of gears, in.
f = width of face of gears, in.
p = circular pitch of gears, in.
y_1 = Lewis tooth form factor for one gear
y_2 = Lewis tooth form factor for mating gear
V = pitch-line velocity, ft. per min.
g = acceleration of gravity = 32.2 ft. per sec.²
E_1 and E_2 = modulus of elasticity of material, lb. per sq.in
Ws = equivalent static tooth load, lb.
W = applied or transmitted tooth load, lb.

Equations (5) and (6) enable the equivalent static tooth load to be determined when the other factors are known. It is also necessary to know the safe static load that a given gear tooth can carry in order to determine the safe working load. This safe static load can be readily calculated by using a slight modification of either the Lewis formula or the Marx and Cutter formula. Of the two, the Lewis formula is somewhat simpler, although it may not be quite as exact. As a matter of fact, exactness is not necessary in many cases because the limiting factor is more often that of wear rather than that of tooth strength. Furthermore, any error that may exist in the Lewis formula is on the side of safety. We will therefore use the Lewis formula, modified as follows, to determine the safe static tooth load:

$$Ws = \frac{S}{k}\,pfy \qquad (7)$$

Where
Ws = safe static tooth load, lb.
S = tensile strength of material, lb. per sq.in.
k = factor of safety

The following factors of safety are suggested:

$k = 3$ for steady loads on single pairs, with no reversal of stress

$k = 4$ for steady loads on the end gears of a train, or for suddenly applied loads on a single pair with no reversal of stress

$k = 5$ for steady loads on intermediate gears of a train

$k = 6$ for suddenly applied loads with reversal of stress on single pairs or on gears of a train.

The foregoing equations are somewhat complex. In order to simplify calculations, several tables have been prepared and the equations have been rearranged to facilitate the use of values from these tables. In the first place, these equations introduce an accuracy factor. This also helps to establish manufacturing tolerances that should be maintained in production. For example,

The tenth article. The eleventh will appear in an early issue.

in equation (5), the relation of the errors on a pair of gears to the circular pitch is $\frac{e}{\sqrt{p}}$. The average order of errors that will be found in a pair of 10-D.P. carefully-made, form-milled gears of a circular pitch of 0.3142 in. is about 0.002 in. The effective percentage of errors, $\frac{e}{\sqrt{p}}$, as it may be called, thus becomes equal to 0.0036. This would be equivalent to an error of about 0.0026 in. on a 6-D.P. gear and about 0.0037 in. on a 3-D.P. gear. These results are very close to the average errors found in carefully-made, form-milled gears of these pitches. The following represents the effective percentage of errors that it should be possible to maintain with different production processes:

Process	$\frac{e}{\sqrt{p}}$
Carefully-ground gears	0.0005
Commercially-ground gears	0.0010
Carefully-generated gears	0.0020
Commercial-generated gears	0.0030
Carefully-milled gears	0.0040
Commercial-milled gears	0.0050

Each process has been divided into two classes: the first where every precaution is taken to secure as accurate results as possible, and the second where reasonable care is taken. Table VII shows for the pitches ordinarily used the extent of the errors in each pitch that would correspond to the foregoing error factors.

In order to simplify the computations, the equations for the beam strength of gear teeth will be arranged for unit loads, or loads per inch of face. The first step in such computations is to determine the safe static load per inch of face for any particular gear that is to be used. We will therefore transpose equation (7) into the following form:

$$\frac{Ws}{f} = \frac{S}{k}\,py \qquad (8)$$

The following values of S are suggested:

Material	Tensile Strength, S Lb. per Sq.In.
Cast iron	24,000
Bronze	36,000
Cast steel, S. A. E. 1,235	45,000
Forged steel, S. A. E. 1,030	60,000
Forged steel, S. A. E. 1,045	90,000
Forged steel, S. A. E. 3,245	120,000

Table VIII—Values of $\frac{L}{f}$ for Steel Gears on Steel Gears

Velocity V Ft. per Min.	Values of $\frac{eY_1\ Y_2}{(y_1+y_2)\sqrt{p}}$								
	0.000025	0.00005	0.000075	0.000100	0.000125	0.0015	0.00020	0.00025	0.00030
100	9	18	27	36	45	54	72	90	108
200	24	47	71	94	118	141	188	235	282
300	40	81	121	161	202	242	323	403	484
400	58	116	175	233	291	349	466	582	699
500	77	153	230	306	383	460	613	766	919
600	95	190	285	380	475	570	760	951	1141
700	114	227	341	454	568	681	908	1135	1362
800	132	264	395	527	659	791	1054	1318	1581
900	150	300	449	599	749	898	1198	1497	1797
1000	167	335	502	670	837	1004	1339	1674	2009
1100	185	369	554	739	924	1108	1478	1847	2217
1200	202	403	605	807	1009	1210	1614	2017	2421
1300	218	437	655	873	1092	1310	1747	2183	2620
1400	235	469	704	939	1173	1408	1877	2346	2816
1500	251	501	752	1003	1253	1504	2005	2506	3008
1600	266	532	799	1065	1331	1597	2129	2662	3194
1700	281	563	844	1126	1407	1689	2252	2814	3377
1800	296	593	889	1186	1482	1779	2372	2965	3558
1900	311	622	933	1245	1556	1867	2489	3112	3734
2000	325	651	976	1302	1627	1953	2604	3255	3906
2200	353	707	1060	1414	1767	2121	2828	3535	4242
2400	380	761	1141	1521	1902	2282	3043	3804	4564
2600	406	813	1219	1625	2031	2438	3250	4063	....
2800	431	863	1294	1725	2157	2588	3451	4314	....
3000	456	911	1367	1822	2278	2733	3645	4556	....
3200	479	958	1437	1916	2395	2874	3833	....	....
3400	502	1004	1506	2008	2509	3011	4015	....	....
3600	524	1048	1572	2096	2620	3144	4192	....	....
3800	546	1091	1637	2182	2728	3273	4364	....	....
4000	567	1133	1700	2266	2833	3399	4532	....	....
4500	617	1233	1850	2467	3084	3700	....	....	....
5000	664	1328	1992	2657	3321	3985	....	....	....
5500	709	1418	2127	2836	3545	4254	....	....	....
6000	752	1503	2255	3007	3759	4510	....	....	....
6500	793	1585	2378	3170	3963	....	....	....	....
7000	832	1663	2495	3326	4158	....	....	....	....
7500	869	1739	2608	3477	4347	....	....	....	....
8000	906	1812	2718	3623	4529	....	....	....	....
8500	941	1882	2822	3763	....	....	....	....	....
9000	975	1949	2924	3899	....	....	....	....	....
9500	1008	2016	3024	4032	....	....	....	....	....
10000	1040	2079	3119	4158	....	....	....	....	....

Table IX—Values of $\frac{L}{f}$ for Cast-Iron Gears on Cast-Iron Gears

Velocity V Ft. per Min.	Values of $\frac{e\, y_1\, y_2}{(y_1 + y_2)\sqrt{p}}$						
	0.000075	0.00010	0.000125	0.00015	0.00020	0.00025	0.00030
100	14	18	23	27	36	45	54
200	36	47	59	71	94	118	141
300	61	81	101	121	161	202	242
400	88	116	146	175	233	291	349
500	115	153	192	230	306	383	460
600	143	190	238	285	380	475	570
700	171	227	284	341	454	568	681
800	198	264	330	395	527	659	791
900	225	300	375	449	599	749	898
1000	251	335	419	502	670	837	1004
1100	277	369	462	554	739	924	1108
1200	302	403	504	605	807	1009	1210
1300	328	437	546	655	873	1092	1310
1400	352	469	587	704	939	1173	1408
1500	376	501	627	752	1003	1253	1504
1600	400	532	666	799	1065	1331	1597
1700	422	563	704	844	1126	1407	1689
1800	445	593	741	889	1186	1482	1779
1900	467	622	778	933	1245	1556	1867
2000	488	651	814	976	1302	1627	1953
2200	530	707	884	1060	1414	1767	
2400	571	761	951	1141	1521	1902	
2600	610	813	1016	1219	1625		
2800	647	863	1079	1294	1725		
3000	684	911	1139	1367	1822		
3200	719	958	1198	1437	1916		
3400	753	1004	1255	1506			
3600	786	1048	1310	1572			
3800	819	1091	1364	1637			
4000	850	1133	1417	1700			

Table X—Values of $\frac{L}{f}$ for Cast-Iron or Bronze Gears on Steel Gears

Velocity V	Values of $\frac{e\, y_1\, y_2}{(y_1+y_2)\sqrt{p}}$							
Ft. per Min.	0.00005	0.000075	0.00010	0.000125	0.00015	0.00020	0.00025	0.00030
100	12	18	24	30	36	48	60	72
200	31	47	62	78	94	125	155	188
300	54	81	108	135	161	216	270	323
400	78	116	156	195	233	311	390	466
500	102	153	204	255	306	408	510	613
600	127	190	254	317	380	507	635	760
700	151	227	302	378	454	604	755	908
800	176	264	352	440	527	704	881	1054
900	200	300	399	499	599	798	998	1198
1000	223	335	446	558	670	892	1115	1339
1100	246	369	492	615	739	985	1228	1478
1200	269	403	538	673	807	1076	1345	1614
1300	291	437	582	728	873	1164	1456	1747
1400	313	469	626	783	939	1252	1566	1877
1500	334	501	668	835	1003	1337	1671	2005
1600	355	532	710	887	1065	1420	1774	2129
1700	375	563	751	938	1126	1502	1876	2252
1800	395	593	791	988	1186	1581	1975	2372
1900	415	622	830	1037	1245	1660	2074	2489
2000	434	651	868	1085	1302	1736	2169	2604
2200	471	707	943	1177	1414	1885	2356	2828
2400	507	761	1014	1267	1521	2028	2534	3043
2600	542	813	1084	1355	1625	2167	2710	
2800	575	863	1152	1437	1725	2305	2875	
3000	607	911	1214	1518	1822	2428	3034	
3200	639	958	1278	1597	1916	2556		
3400	669	1004	1338	1673	2008	2677		
3600	699	1048	1398	1747	2096	2796		
3800	727	1091	1454	1818	2182	2909		
4000	755	1133	1511	1887	2266	3021		

Table XI—Values of Equivalent Static Tooth Load per Inch of Face, $\frac{Ws}{f}$ Lb.

Applied Load $\frac{W}{f}$ Lb.	Increment Load per Inch of Face. $\frac{L}{f}$ Lb.																													Applied Load $\frac{W}{f}$ Lb.
	10	20	30	40	50	60	70	80	90	100	120	140	160	180	200	250	300	350	400	450	500	550	600	650	700	750	800	850	
50	72	82	89	95	100	105	109	113	117	121	127	134	139	145	150	162	172	182	191	200	208	216	223	230	237	244	250	256	50
75	102	114	123	130	136	142	148	153	157	162	168	177	185	191	197	212	225	237	248	259	269	278	287	296	304	312	320	328	75
100	132	145	155	163	171	177	184	189	195	200	210	218	226	234	241	258	273	287	300	312	324	335	345	355	365	374	383	392	100
125	161	175	186	196	204	212	218	225	231	237	248	257	266	274	283	302	319	335	349	362	375	387	399	410	421	431	441	451	125
150	189	205	217	227	237	245	252	260	266	272	284	295	305	314	323	344	362	379	395	410	424	437	450	462	474	485	496	507	150
175	217	234	247	259	269	278	286	294	301	307	320	331	342	352	362	384	404	423	440	456	471	485	499	512	525	537	549	561	175
200	245	263	277	289	300	310	318	326	334	341	355	367	379	390	400	424	445	465	483	500	516	532	546	561	574	587	600	612	200
250	300	321	337	350	362	372	382	391	400	408	423	437	450	462	474	500	524	546	566	585	604	621	637	653	668	683	697	711	250
300	355	377	395	410	422	434	445	455	464	473	490	505	519	532	545	574	600	624	646	664	687	706	724	742	758	774	790	805	300
350	409	423	448	468	482	495	506	517	527	537	555	571	586	600	614	646	674	700	724	746	768	789	808	826	844	862	879	895	350
400	463	489	510	526	541	555	567	579	590	600	619	637	653	668	683	716	746	774	800	824	847	869	890	910	929	948	966	983	400
450	517	545	566	584	600	614	627	640	651	662	682	701	718	734	750	785	817	846	874	900	924	947	970	991	1011	1031	1050	1068	450
500	571	600	622	641	658	673	687	700	712	724	745	765	783	800	816	854	887	918	947	974	1000	1024	1048	1070	1092	1112	1132	1152	500
550	624	655	678	698	716	732	746	760	772	785	807	828	847	865	881	921	956	988	1019	1047	1074	1100	1124	1148	1171	1192	1213	1234	550
600	677	710	734	755	773	790	805	819	832	845	868	890	910	929	946	987	1024	1058	1090	1120	1148	1174	1200	1225	1248	1271	1293	1314	600
650	731	764	790	811	830	848	863	878	892	905	929	952	973	992	1010	1053	1092	1127	1160	1191	1220	1248	1275	1300	1324	1348	1371	1394	650
700	784	818	845	867	887	905	921	937	951	965	990	1013	1035	1055	1074	1118	1158	1194	1229	1261	1292	1321	1348	1374	1400	1425	1448	1471	700
750	837	872	900	923	944	962	979	995	1010	1024	1050	1074	1096	1117	1137	1183	1224	1262	1298	1331	1362	1392	1421	1448	1475	1500	1525	1549	750
800	889	926	955	979	1000	1019	1037	1053	1068	1083	1110	1135	1157	1179	1200	1247	1290	1329	1366	1400	1432	1463	1493	1521	1548	1575	1600	1625	800
850	943	980	1010	1035	1056	1076	1094	1111	1127	1142	1170	1195	1218	1241	1262	1311	1355	1395	1433	1468	1502	1534	1564	1593	1621	1648	1675	1700	850
900	995	1034	1064	1090	1112	1132	1151	1168	1185	1200	1229	1255	1279	1302	1324	1374	1420	1461	1500	1536	1571	1604	1635	1666	1694	1722	1749	1775	900
950	1048	1088	1119	1145	1168	1189	1208	1226	1243	1258	1288	1315	1340	1363	1386	1437	1484	1526	1566	1603	1639	1673	1705	1736	1765	1794	1822	1849	950
1000	1100	1141	1173	1200	1224	1245	1265	1283	1300	1316	1346	1374	1400	1424	1447	1500	1548	1592	1632	1671	1707	1742	1775	1806	1837	1866	1894	1922	1000
1100	1205	1248	1282	1310	1335	1357	1377	1397	1415	1432	1463	1492	1520	1545	1569	1625	1674	1719	1763	1803	1842	1878	1912	1945	1977	2008	2038	2067	1100
1200	1310	1355	1390	1419	1445	1468	1490	1510	1529	1546	1579	1610	1638	1664	1690	1748	1800	1848	1893	1936	1975	2013	2049	2084	2117	2149	2180	2210	1200
1300	1414	1461	1497	1528	1555	1579	1602	1622	1642	1661	1695	1727	1756	1784	1810	1870	1925	1975	2021	2063	2106	2146	2183	2219	2254	2288	2320	2351	1300
1400	1518	1567	1605	1637	1665	1690	1713	1735	1755	1774	1810	1843	1873	1902	1929	1992	2048	2100	2148	2194	2237	2278	2317	2354	2390	2425	2458	2491	1400
1500	1622	1673	1712	1745	1774	1800	1824	1846	1867	1887	1924	1958	1990	2020	2048	2112	2171	2226	2275	2322	2366	2409	2449	2488	2525	2561	2595	2629	1500
1600	1726	1779	1819	1853	1883	1910	1935	1956	1979	2000	2038	2073	2106	2136	2166	2232	2293	2349	2400	2449	2494	2538	2580	2620	2658	2695	2731	2766	1600
1700	1830	1884	1926	1961	1992	2019	2045	2069	2091	2112	2151	2188	2222	2254	2283	2352	2414	2474	2525	2574	2622	2667	2710	2751	2791	2829	2866	2902	1700
1800	1934	1990	2032	2068	2100	2129	2155	2179	2202	2224	2265	2302	2337	2369	2400	2471	2535	2595	2649	2700	2749	2796	2839	2882	2923	2962	3000	3037	1800
1900	2038	2095	2139	2176	2208	2238	2265	2290	2314	2336	2378	2416	2452	2485	2516	2589	2655	2717	2772	2824	2875	2923	2968	3011	3053	3094	3133	3171	1900
2000	2141	2200	2245	2283	2316	2346	2374	2400	2424	2447	2490	2529	2566	2600	2632	2707	2775	2837	2894	2949	3000	3049	3095	3140	3183	3225	3265	3304	2000
2200	2348	2410	2457	2497	2532	2563	2592	2620	2645	2669	2714	2755	2793	2828	2863	2942	3012	3077	3138	3194	3249	3300	3349	3395	3441	3485	3527	3568	2200
2400	2555	2619	2668	2710	2746	2779	2810	2838	2864	2890	2936	2980	3019	3057	3093	3175	3249	3316	3380	3438	3495	3549	3600	3649	3696	3742	3786	3829	2400
2600	2761	2828	2879	2922	2961	2995	3027	3056	3084	3110	3158	3203	3245	3284	3321	3406	3483	3553	3620	3681	3740	3796	3849	3900	3949	3996	4042	4087	2600
2800	2967	3037	3090	3135	3174	3210	3243	3273	3302	3329	3379	3426	3469	3510	3545	3637	3717	3790	3858	3921	3983	4040	4096	4149	4200	4249	4297	4343	2800
3000	3173	3245	3300	3346	3387	3424	3458	3490	3520	3548	3600	3648	3693	3735	3775	3866	3949	4025	4095	4162	4225	4285	4342	4396	4449	4500	4549	4597	3000
3200	3379	3453	3510	3558	3600	3638	3673	3706	3737	3766	3810	3869	3915	3958	4000	4094	4180	4258	4331	4399	4465	4527	4586	4643	4697	4749	4800	4849	3200
3400	3584	3661	3719	3769	3812	3851	3888	3922	3954	3983	4038	4090	4138	4182	4225	4322	4410	4490	4566	4636	4704	4767	4828	4886	4943	4997	5049	5100	3400
3600	3790	3868	3929	3979	4024	4064	4102	4137	4170	4200	4257	4310	4358	4405	4449	4549	4639	4721	4800	4872	4942	5007	5070	5130	5187	5243	5297	5349	3600
3800	3995	4076	4138	4190	4236	4277	4316	4352	4385	4416	4475	4529	4580	4627	4672	4775	4868	4953	5033	5106	5178	5245	5310	5371	5431	5488	5544	5597	3800
4000	4200	4283	4346	4400	4447	4490	4529	4566	4600	4632	4693	4748	4800	4849	4894	5000	5095	5183	5265	5342	5414	5483	5549	5612	5673	5732	5789	5844	4000
4200	4405	4490	4555	4610	4658	4702	4743	4780	4814	4848	4910	4967	5020	5069	5117	5225	5323	5412	5496	5573	5649	5719	5787	5852	5915	5976			4200
4400	4610	4697	4763	4820	4869	4914	4955	4994	5030	5063	5127	5185	5239	5290	5338	5449	5549	5639	5727	5806	5883	5956							4400
4600	4814	4903	4971	5029	5080	5126	5168	5206	5243	5278	5343	5402	5458	5510	5559	5672	5775	5867	5956										4600
4800	5019	5110	5179	5238	5290	5337	5380	5420	5457	5493	5559	5620	5678	5729	5780	5895	6000												4800
5000	5224	5316	5387	5447	5500	5548	5592	5632	5671	5707	5775	5837	5894	5949	6000														5000

Table XI (Continued)—Values of Equivalent Static Tooth Load per Inch of Face, $\frac{Ws}{f}$ Lb.

Applied Load $\frac{W}{f}$ Lb.	Increment Load per Inch of Face, $\frac{L}{f}$ Lb.																												Applied Load $\frac{W}{f}$ Lb.
	900	950	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2200	2400	2600	2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	
50	262	268	274	285	295	305	315	324	333	342	350	358	366	382	396	411	424	437	450	462	474	486	497	508	519	530	540	550	50
75	335	342	349	363	375	387	399	410	421	432	442	452	462	481	499	516	533	549	565	580	595	609	623	636	649	662	674	686	75
100	400	408	416	432	446	461	474	487	500	512	524	536	547	569	590	610	629	648	666	683	700	716	732	748	763	778	793	807	100
125	460	469	479	496	512	528	543	558	572	586	599	612	625	649	673	695	717	737	757	777	796	814	832	850	867	883	899	915	125
150	517	527	537	556	574	592	608	624	640	655	670	684	698	724	750	774	798	821	843	864	885	905	925	944	963	981	1000	1016	150
175	572	583	593	614	633	652	670	687	704	720	736	752	767	795	823	849	875	900	923	946	968	990	1011	1032	1052	1072	1086	1110	175
200	624	636	647	669	690	710	729	748	766	783	800	816	832	863	893	921	948	975	1000	1025	1049	1072	1095	1117	1138	1159	1180	1200	200
250	724	737	750	775	798	821	842	862	882	902	921	939	957	991	1025	1056	1087	1116	1144	1172	1199	1225	1250	1275	1299	1322	1345	1368	250
300	820	834	848	875	900	925	948	971	993	1014	1035	1055	1075	1112	1149	1183	1217	1249	1280	1310	1339	1368	1395	1422	1449	1475	1500	1525	300
350	911	926	942	971	998	1025	1050	1075	1098	1121	1144	1166	1187	1227	1267	1304	1340	1375	1408	1441	1472	1503	1533	1562	1591	1619	1646	1673	350
400	1000	1016	1032	1063	1093	1121	1148	1174	1200	1225	1249	1272	1294	1337	1380	1419	1458	1495	1531	1566	1600	1632	1664	1696	1726	1756	1785	1814	400
450	1086	1104	1121	1154	1185	1215	1244	1272	1298	1324	1350	1375	1399	1444	1489	1531	1573	1612	1650	1687	1723	1758	1792	1825	1857	1889	1920	1950	450
500	1171	1189	1207	1242	1275	1307	1337	1366	1394	1422	1449	1475	1500	1548	1595	1639	1683	1725	1765	1804	1841	1878	1914	1949	1983	2017	2049	2081	500
550	1254	1270	1292	1328	1362	1395	1427	1458	1488	1517	1545	1572	1599	1650	1699	1746	1791	1835	1876	1917	1957	1996	2033	2070	2106	2141	2175	2208	550
600	1335	1355	1375	1413	1449	1484	1517	1549	1580	1610	1639	1667	1695	1748	1800	1849	1896	1942	1985	2028	2069	2110	2149	2187	2224	2261	2297	2332	600
650	1416	1438	1456	1495	1533	1569	1604	1638	1670	1702	1732	1761	1790	1845	1899	1950	1999	2046	2092	2137	2180	2222	2262	2302	2341	2379	2416	2453	650
700	1494	1515	1537	1571	1617	1654	1690	1725	1758	1791	1823	1854	1883	1940	1996	2049	2100	2149	2196	2243	2287	2331	2373	2415	2455	2494	2533	2571	700
750	1572	1596	1616	1658	1699	1738	1775	1811	1845	1879	1912	1944	1975	2034	2092	2146	2199	2250	2299	2347	2393	2438	2482	2525	2566	2607	2647	2686	750
800	1649	1672	1694	1738	1780	1820	1858	1895	1931	1966	2000	2033	2065	2126	2186	2242	2297	2349	2400	2449	2497	2544	2589	2633	2676	2718	2759	2800	800
850	1725	1750	1772	1817	1860	1901	1941	1979	2016	2053	2087	2121	2154	2217	2278	2336	2393	2447	2499	2550	2599	2647	2693	2739	2783	2827	2870	2912	850
900	1800	1825	1849	1895	1939	1982	2023	2062	2100	2137	2173	2208	2242	2307	2370	2429	2487	2543	2596	2649	2700	2749	2797	2844	2890	2935	2976	3021	900
950	1875	1900	1925	1972	2018	2061	2103	2144	2183	2221	2258	2293	2328	2395	2460	2521	2581	2638	2693	2747	2799	2850	2899	2948	2994	3040	3085	3129	950
1000	1949	1975	2000	2049	2095	2140	2183	2225	2265	2304	2342	2378	2414	2483	2549	2612	2673	2732	2790	2844	2897	2949	3000	3049	3097	3145	3191	3236	1000
1100	2095	2122	2149	2200	2249	2296	2341	2385	2427	2468	2507	2545	2583	2655	2725	2791	2855	2917	2976	3034	3090	3145	3198	3249	3300	3349	3397	3445	1100
1200	2239	2267	2295	2349	2400	2449	2496	2542	2586	2629	2670	2710	2749	2824	2897	2965	3033	3097	3159	3220	3278	3335	3390	3445	3498	3549	3600	3649	1200
1300	2382	2413	2440	2496	2549	2600	2649	2696	2742	2787	2830	2872	2912	2990	3066	3138	3208	3275	3340	3402	3463	3523	3580	3637	3691	3745	3798	3850	1300
1400	2523	2555	2583	2640	2696	2749	2800	2849	2897	2943	2987	3030	3073	3154	3233	3307	3380	3449	3517	3582	3645	3707	3766	3825	3882	3938	3992	4046	1400
1500	2662	2695	2725	2784	2842	2896	2949	3000	3049	3097	3143	3188	3232	3315	3397	3474	3549	3621	3691	3758	3823	3887	3949	4010	4069	4127	4183	4239	1500
1600	2800	2834	2865	2926	2986	3042	3097	3149	3200	3249	3297	3344	3389	3475	3560	3639	3717	3791	3864	3932	4000	4066	4129	4192	4253	4313	4371	4428	1600
1700	2937	2972	3004	3067	3128	3186	3243	3297	3349	3400	3449	3497	3544	3633	3720	3802	3882	3958	4032	4104	4174	4242	4308	4372	4435	4496	4556	4615	1700
1800	3073	3108	3142	3207	3270	3329	3387	3443	3497	3549	3600	3649	3697	3789	3878	3963	4045	4124	4200	4274	4346	4415	4483	4550	4615	4678	4739	4800	1800
1900	3208	3244	3278	3346	3410	3472	3531	3588	3644	3697	3749	3800	3849	3943	4035	4122	4207	4287	4365	4442	4515	4587	4657	4725	4791	4856	4920	4982	1900
2000	3342	3378	3414	3483	3549	3612	3673	3732	3789	3844	3897	3949	4000	4097	4191	4280	4366	4449	4529	4608	4683	4757	4828	4898	4966	5033	5098	5162	2000
2200	3607	3654	3683	3754	3825	3892	3955	4017	4076	4134	4190	4245	4298	4400	4498	4591	4682	4769	4854	4935	5014	5091	5166	5240	5311	5381	5450	5517	2200
2400	3870	3910	3949	4023	4097	4166	4233	4298	4360	4420	4478	4536	4591	4697	4800	4897	4992	5083	5173	5257	5339	5420	5499	5575	5650	5723	5794	5864	2400
2600	4130	4171	4212	4290	4366	4440	4508	4575	4640	4703	4763	4823	4880	4991	5098	5200	5298	5393	5486	5573	5659	5743	5825	5905	5982				2600
2800	4387	4430	4473	4553	4633	4708	4780	4850	4917	4982	5045	5107	5166	5281	5392	5498	5600	5698	5794	5885	5975								2800
3000	4643	4688	4732	4816	4897	4975	5049	5121	5191	5259	5324	5388	5449	5568	5683	5792	5898	6000											3000
3200	4897	4944	4989	5077	5160	5240	5317	5392	5463	5533	5600	5666	5730	5951	5971														3200
3400	5149	5197	5244	5334	5420	5503	5582	5658	5732	5805	5874	5938	6008																
3600	5400	5449	5497	5590	5678	5764	5845	5924	6000																				
3800	5649	5700	5749	5845	5935	6023																							
4000	5897	5949	6000																										

The next operation is to determine the value of L. This will be calculated by the use of equation (5), which has been rearranged as follows to simplify the computations by the use of the following tables:

$$\frac{L}{f} = \left[\frac{ey_1y_2}{(y_1 + y_2)\sqrt{p}}\right] \left[\frac{V^{\frac{1}{2}}}{\left(g\frac{1}{E_1} + \frac{1}{E_2}\right)(V + 1{,}200)}\right] \quad (9)$$

The values of $\frac{e}{\sqrt{p}}$ contained in Table VII will be multiplied by $\frac{y_1y_2}{y_1 + y_2}$ to obtain the value of the first part of equation (9). Tables VIII, IX, and X give values of $\frac{L}{f}$ for different velocities and different values of the first part of equation (9) for gear combinations of steel with steel, cast iron with cast iron, and cast iron or bronze with steel, respectively. Intermediate values can be readily obtained by interpolation when required.

The next step is to determine the equivalent static tooth load per inch of face by means of equation (6), which has been transposed as follows:

$$\frac{Ws}{f} = \frac{W + \sqrt{WL}}{f} \quad (10)$$

Table XI give values of $\frac{Ws}{f}$ corresponding to various combinations of different values of $\frac{W}{f}$ and $\frac{L}{f}$. In use, the values of $\frac{Ws}{f}$ and $\frac{L}{f}$ would be established from equations (8) and (9). The value of $\frac{W}{f}$ would then be taken from these tables according to the calculated values of the other two factors. This would give the maximum safe load per inch of face for the gears in question.

Non-Metallic Pinions

In order to reduce noise and vibration, particularly of high-speed gears, the pinion is often made of some non-metallic material, such as rawhide, fiber, Bakelite, Micarta, or Fabroil. Such pinions are extensively used for electric motor pinions to drive other metal gears.

The characteristics of these materials are so different from the characteristics of metals that gears employing these non-metallic materials should be considered by themselves. Due to their low modulus of elasticity, most of the effects of errors in tooth form and spacing are absorbed at the surface of the gear teeth and have relatively little effect on the strength of the gears. In addition, the profiles of the teeth of these non-metallic gears tend to conform to the conjugate form of their mating teeth very quickly, thus reducing still further any effects of errors. In these installations, it is of advantage to have the number of teeth in the metal gear an even multiple of the number of teeth in the non-metallic pinion so that the form of the teeth in this pinion will conform to the smallest possible number of mating teeth.

Very little definite experimental data are available as to the strength of such gears in operation. Tests so far made on the Lewis machine at the Massachusetts Institute of Technology with such gears have given negative results; that is, the effects of very small errors on the hardened-steel master gears have been greater than the effects of about ten-times larger errors on the non-metallic gears. Under these conditions, the effects of accuracy become of lesser importance. In the absence of more definite information, a constant value of L/f may be used in estimating the equivalent static tooth load with a given transmitted load at a given pitch-line velocity. Suggested values for such use are given in the following table:

Pitch-Line Velocity, Ft. per Min	100	200	300	400	500	600	700	800	900	1,000
$\frac{L}{f}$	8	20	35	50	66	82	97	113	129	144
Pitch-Line Velocity, Ft. per Min.	1,200	1,400	1,600	1,800	2,000	2,200	2,400	2,600	2,800	3,000
$\frac{L}{f}$	173	201	229	255	280	304	327	349	370	391
Pitch-Line Velocity, Ft. per Min.	3,200	3,400	3,600	3,800	4,000	4,200	4,400	4,600	4,800	5,000
$\frac{L}{f}$	411	431	450	469	487	504	521	538	554	570

The tensile strength of Bakelite and Micarta may be taken as 24,000 lb. per sq.in. Other than using a constant value from the foregoing table of L/f, the calculations for the strength of these non-metallic gear teeth will be the same as those for metal gears as described above.

We will now take a definite example to illustrate the use of these tables and equations. We will take a pair of 2-D.P. gears, 20 and 60 teeth, 14½-deg. composite tooth form, running at a pitch-line velocity of 380 ft. per min. and transmitting a steady load of 175 hp. These gears will be made of S.A.E. 1045 steel. The first step towards determining the width of face is to calculate the maximum safe tooth load per inch of face for the 20-tooth pinion, since this is the weakest member of the pair in this example. Using equation (8), we have

$$\frac{Ws}{f} = \frac{S}{k}py$$

$S = 90{,}000$ lb. per sq. in.
$k = 3$
$p = 1.5708$ in.
$y = 0.090$.

Whence $\frac{Ws}{f} = \frac{90{,}000}{3} \times 1.5708 \times 0.090 = 4{,}241$ lb.

The next step is to determine the value of $\frac{L}{f}$. These will be commercial milled gears, and the value of the effective percentage of error should not be greater than 0.0050. Solving the first part of equation (9), with the following values, we have:

$$\frac{e}{\sqrt{p}} = 0.0050$$

$y_1 = 0.090$ (20-tooth gear)
$y_2 = 0.114$ (60-tooth gear)

$$\frac{ey_1y_2}{(y_1 + y_2)\sqrt{p}} = 0.00025.$$

From the table of $\frac{L}{f}$ for steel witn steel, under the column headed with this factor of 0.00025, at a speed of 400 ft. per min. we find that $\frac{L}{f}$ equals 582. The

next step is to determine the safe working load per inch of face. We now have values for $\frac{Ws}{f}$ and $\frac{L}{f}$. With these two values, from the tables of $\frac{Ws}{f}$, under the column where L/f equals 600 we find that when Ws/f equals 4,342 lb. that W/f equals 3,000 lb. This should be our maximum working load per inch of face.

The next step is to determine the total working tooth load. This tooth load, W, when transmitting 175 hp. at a pitch-line velocity of 380 ft. per min. is equal to

$$W = \frac{33{,}000 \times 175}{380} = 15{,}200 \text{ lb.}$$

Whence if

$$\frac{W}{f} = 3{,}000, \text{ and } W = 15{,}200, f = \frac{15{,}200}{3{,}000} = 5.66 \text{ in.}$$

This would be the minimum width of face for the gears as regards the tooth strength alone. These gears should also be checked for wear before definitely establishing the width of face. The probability is that a materially wider face will be necessary to make them safe for wear. This matter of wear will be discussed later.

As a second example we will take a pair of gears which are to transmit 300 hp. at a pitch-line velocity of 2,200 ft. per min. The pinion will be made of forged steel while the gear will be made with a forged steel ring. These gears are 3-D.P., 20-deg. full depth tooth gears, of generated form, with 21 and 84 teeth. The first step is to calculate the safe static tooth loads. Using equation (8) and the following values, we have:

Pinion	Gear
$S = 90{,}000$ lb. per sq.in.	$S = 90{,}000$ lb. per sq.in.
$k = 3$	$k = 3$
$p = 1.0472$ in.	$p = 1.0472$ in.
$y = 0.102$	$y = 0.131$
$\frac{Ws}{f} = \frac{S}{k} py = 3{,}204$ lb.	$\frac{Ws}{f} = 4{,}114$ lb.

In the further calculations we will use the value of the weaker tooth which, in this case, is the pinion.

The next step is to determine the value of $\frac{L}{f}$. These will be carefully generated gears, so that the value of $\frac{e}{\sqrt{p}}$ should not exceed 0.0020. As a matter of fact, if the errors are even as large as this, the drive may be objectionably noisy even though the gears are strong enough to carry the load. For the purposes of strength calculations, however, we should assume that larger errors, rather than smaller ones than may actually exist, are present. Solving the first part of equation (9) with the following values, we have:

$$\frac{e}{\sqrt{p}} = 0.0020$$

$$y_1 = 0.102$$

$$y_2 = 0.131$$

$$\frac{e y_1 y_2}{(y_1 + y_2)\sqrt{p}} = 0.000115$$

From the table of $\frac{L}{f}$ for steel with steel, interpolating between the columns headed with 0.00010 and 0.000125, for a pitch-line velocity of 2,200 ft. per min. we get

$$\frac{L}{f} = 1{,}626$$

The next step is to determine the safe unit working load, $\frac{W}{f}$. This we obtain from the table of $\frac{Ws}{f}$ as before, using the following values in the table:

$$\frac{L}{f} = 1{,}700 \text{ lb.}$$

$$\frac{Ws}{f} = 3{,}249 \text{ lb.}$$

Whence $\frac{W}{f} = 1{,}600$ lb.

The next step is to determine the total working load, as follows:

$$W = \frac{33{,}000 \times \text{hp.}}{V} = \frac{33{,}000 \times 300}{2{,}200} = 4{,}500 \text{ lb.}$$

Whence if $\frac{W}{f} = 1{,}600$ and $W = 4{,}500$, $f = \frac{4{,}500}{1{,}600} = 2.8$ in. This would be the minimum safe width of face on the basis of tooth strength alone. This face should also be checked for wear, as it is probable that a much wider face is necessary to obtain a reasonable length of life.

Climbing Out of the Rut—Discussion

By G. B. Stuart

In the discussion by Lawrence F. Swenson on page 517, Vol. 65, of the *American Machinist*, Mr. Swenson seems to have taken the matter of Entropy's wit too much to heart. I think that when he has turned over some of those thirty prospective years in mechanical service he will be as "hard shelled" as the rest of us, and know that it sometimes takes an "awful wallop" to get a point over. However, while I feel that Entropy has purposely overdrawn the situation, yet I am inclined to agree with Mr. Swenson in his conclusions that machine tool design has advanced remarkably in the past half century.

True, the principle of the lathe has remained the same, but so has the principle of the automobile. A multitude of small mechanical refinements, new steels, and the addition of auxiliary accessories has made the automobile capable of going faster and smoother. The same is true of the lathe or milling machine. Careful design of details, new materials, and the addition of the geared head and other auxiliary features makes the modern lathe capable of cutting faster and smoother. But the lathe is still intended for cutting just as the automobile is still used for transporting.

Last year the Lodge and Shipley Machine Tool Company got out a little booklet entitled "200 years, The Evolution of the Lathe." It illustrated several lathes of the 18th century, Maudslay's screw-cutting lathe of 1800, the boring lathe of 1830, and later types up to the present selective-head manufacturing lathe. The design advances plainly evident between the types of the years 1840, 1878, 1900 and 1926 are remarkable.

The principle of the lathe is not going to change, but it is a safe bet to say that the lathe of 1950 will not look like that of 1926. I am not afraid that the hard knocks of Entropy will discourage beginners. More likely, Mr. Swenson and the other young engineers of his generation will unconsciously take the jolt so much to heart that they will go out and design machines that will make the progress of the past look small.

The "Economy of Knowledge" in Business

By Dr. Julius Klein
Director of the Bureau of Foreign and Domestic Commerce, Department of Commerce

THERE have been many contributions of late, upon what might be called the pathology of business—analyses of the causes of commercial mortality and, conversely, the definition of the reasons for assured longevity. Almost everyone of these explorations of the life-cycles of typical trades and industries brings out clearly the fact that the major cause of mortality is not found among the commonly accepted alibis for failure: excessive wages, discriminatory freight rates, inaccessible raw materials, remoteness of markets, etc. The cause is, rather, in the lack of intelligent buying and selling. Clearly one of the outstanding needs for the maintenance of stable conditions in industry and commerce at present, therefore, is the spread of applied research in marketing.

Smaller Units Need Systematizing

Much has been done in the elimination of waste in a dozen avenues of production activity, within recent years, but there is still a vast, almost totally unexplored field of saving on the part of the smaller units in our industrial and commercial organizations, with regard to their buying and selling. The mortality records of recent "casualties" reveal all too clearly that the way to success in these days lies through the conservation of effort by the elimination of non-productive sales and purchasing methods. A recent Department of Commerce analysis of the status of 350 firms in a certain line of manufacturing revealed that the outstanding leader in that industry was the only one in the group employing a business analyst. An examination of the relative prosperity of various members of one section of the industry brought out the fact that its older members on the Atlantic seaboard were much concerned with the steadily increasing Western competition which they admitted could probably have been retarded by the earlier application of some intensive technical research, a step that had been taken only recently by some of the eastern leaders in the industry. These leaders had been relying too long on their supposed "superior experience" and longer training in the industry.

As a matter of fact, it may be frankly doubted whether experience really is the "best teacher" in the field of commerce and industry if we take "experience" to mean the accumulation of tradition and a devout adherence to past practices. It may seem heresy to suggest it, but there are times when over-confidence in past methods and trade processes is well-nigh disastrous. In pre-war days it was a common European pasttime in certain trades to scorn American competition as ephemeral because of the rank extravagance of our plants, because we abandoned as trash great quantities of material which other peoples would find of value. Quite the contrary; our industry has grown precisely because it has the highest scrap heap in the world, because it has consistently refused to be bound by past practices solely because they were sanctified with age.

All too frequently do we find otherwise competent firms misinterpreting activity for prosperity. A leading element in the machinery industry last year had a turnover of $14,000,000. Inquiries addressed to its various members as to business conditions brought back favorable responses, but the final check-up revealed that the ten companies in that line showed a total profit of only $130,000. It would seem that instead of asking each other the usual "How's business?" the query should have been "How are profits?" The helter-skelter cultivation of markets is one of the commonest evidences of the "extravagance of ignorance" in industry.

For example, the survey of New England trade now being conducted by the Department of Commerce is revealing numerous instances of wide-spread and frantic efforts on the part of individual firms to gain national markets. The results in most cases were filled order books but by no means filled coffers. In other words, increased sales costs materially lowered the margin of net profits and in all too many cases this serious situation was unknown because of the lack of adequate accounts. The latter is again an evident need for economy through accurate knowledge, and especially through far-sighted sales planning based on sound marketing research.

Especially in some of our older industrial areas would there seem to be room for greater diversification of output. Far too many factories have evidently been "carrying their eggs in one basket." In the midst of the difficulties which have been upsetting textile mills in various sections, one Providence establishment has stood out as conspicuously successful for the simple reason that its far-sighted management, after the 1921 drop in business, had turned to a variety of related but widely divergent lines such as cord fabrics for tires, tapestries, bedspreads, and chair coverings, which have found outlets in widely scattered industries and have thereby given stability to the organization. In this respect many of the newer industrial enterprises in the South and West have a decided advantage in that they are being operated by their owners who have a lively and immediate interest in the operation of the plant. The dead hand of absentee ownership and direction is almost an assurance of a lack of initiative.

The Department of Commerce can, perhaps, plot the course, take soundings and set up beacon lights of warning at appropriate danger points, but the individual manufacturer and dealer must in every case navigate his own craft. The government, the various trade associations and the educational establishments can at best do nothing more than help industry to help itself.

Abstract of an address delivered before the New England Council at its annual meeting in Hartford, Conn., Nov. 19, 1926.

A Radius Planing Attachment—Discussion

By James McIntosh

I was interested in the article by Michael Kelly, under the title given above, and published on page 562, Vol. 65, of the *American Machinist*, because an exactly similar device was introduced in 1878 in the shipyards of John Key and Sons, Kirkcaldy, Scotland. The device was designed by my father and was used for planing bar links for marine engines.

A similar device was fitted to a Whitworth slotting machine for making box links. Another attachment to the same slotting machine, was a counterweight, which eliminated the breaking away of the lower edge of the work, through slackness in the ram fittings.

Diversified Equipment Used in Making Ignition-Generators

By Frank J. Oliver, Jr.
Editorial Staff, *American Machinist*

Milling, broaching, hobbing, threading, tapping, drilling, grinding, and automatic turning machines are called upon to produce a large number of small but intricate parts

ONE of the customary forms of ignition and generating equipment in general use on automobiles at the present time is the ignition-generator, in which the breaker and distributor mechanism is combined with the generator in a unit assembly. The North East Electric Co., Rochester, N. Y., manufactures such an ignition-generator for Reo motor cars. As can be seen in the accompanying sectional view, Fig. 1, the North East ignition-generator unit consists essentially of an armature carried on ball bearings and revolving between pole-pieces provided with field coils, and an ignition timer-distributor mounted at the commutator end of the machine and driven by means of a sliding gear on the armature shaft extension.

The armature shaft shown in Fig. 2 is turned from bar stock in a Cleveland automatic screw machine. This operation includes the forming of the taper for the gear seat, the rough turning of the shaft end for the subsequent threading operation, the forming of the combination shoulder for the armature core and the outboard bearing, and the general roughing of the remainder of the piece. After the commutator end is centered, the piece is finally cut off.

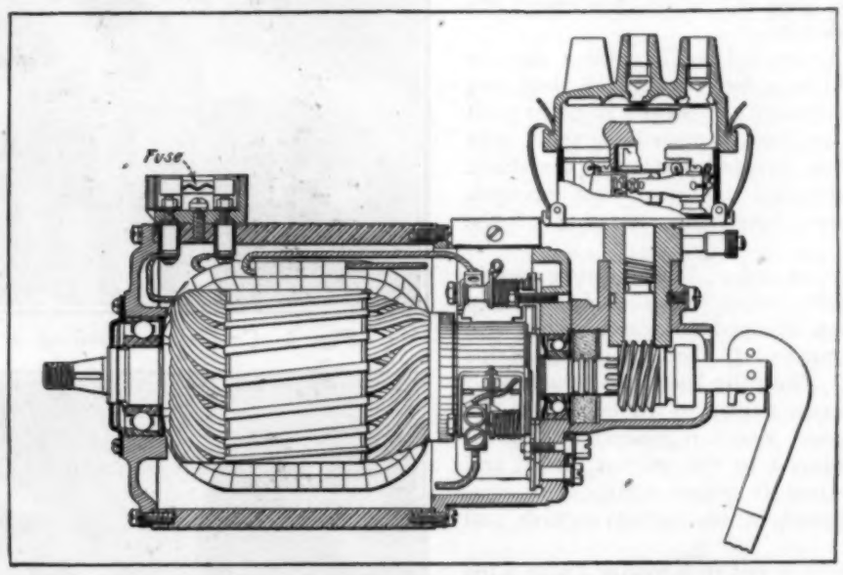


Fig. 1—Automobile ignition-generator unit

With the roughing operation completed, the shaft is placed in a No. 4 Warner & Swasey lathe, where the gear end is centered and threaded with a Geometric die head, $\frac{7}{16}$-in. by 14-th. U.S.S. chasers being used. The central portion of the shaft is also threaded in a Geometric threading machine in the following operation. This thread engages the nut that clamps the armature laminations in place against the shoulder at the gear end of the shaft. The coil slots in the laminated core are spiral. This effect is produced by providing in the hole of each lamination a keyway slot that engages a spiral key set in a spiral groove cut in the shaft. Fig. 3 shows this operation being performed in a Garvin milling machine. Three $\frac{1}{4}$-in. wide cutters 2 in. in diameter are mounted on the spindle. One end of each shaft is held in a dead center, while the other is driven by means of a dog from an indicating head, and the rotation of the head is synchronized with the table feed mechanism to produce the desired spiral. Since the milling cutter advances into the threaded area, it is necessary to rethread the central portion of the shaft in the Geometric threading machine.

The piece is then returned to the Warner & Swasey where the shaft is necked for the bearing seat, grooved for oil retainers, and chamfered. That portion of the shaft over which the commutator bars will be mounted is knurled or serrated with deep cuts parallel to the axis of the shaft.

The No. 3 Woodruff keyway in the tapered gear seat is cut in a No. 6 Whitney hand mill. After washing, the body is ready for grinding in a Cincinnati centerless grinder, and in Fig. 4 this operation is illustrated. The taper for the gear seat is also ground, but in a No. 2 bath grinder by means of a taper-grinding attachment and an Alundum wheel. Spline cutting of the commutator end of the shaft for engagement with the sliding distributor gear is performed in a Barber-Colman gear-cutting machine employing a hob, and the rough edges that result are filed off in a B. & S. high-speed lathe. The shaft is finally given a scratch brush

The first article. The second will appear in an early issue.

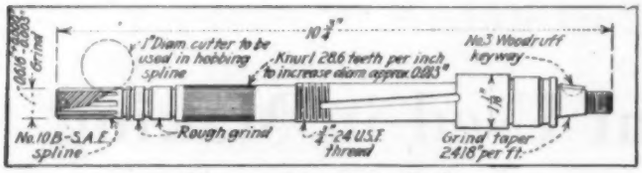

10 3/4"
1" Diam cutter to be used in hobbing spline
Knurl 28.6 teeth per inch to increase diam approx .0185"
No.3 Woodruff keyway
.0615-.0635" Grind
No.10B-S.A.E. spline
Rough grind
3/4"-24 U.S.F. thread
Grind taper 24/8" per ft.

Fig. 2—Armature shaft

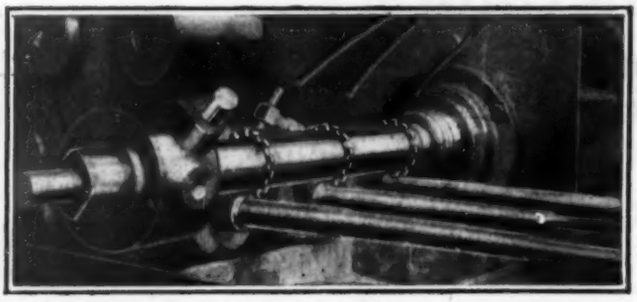


Fig. 3—Milling spiral grooves in the armature shaft

finish, then inspected and placed in parts stock to await armature assembly.

Extruded bar copper is the material from which the commutator bars are punched. Assembly of the bars and the mica insulation pieces is performed by hand in a fixture provided with a removable center plug. A strip of gummed paper is used to hold the assembly together, and in this condition it is placed in a special chuck and heated. While the bar assembly is hot, the chuck is tightened so as to compress the unit, which is then allowed to cool under pressure. Without removing it from the chuck, both ends of the assembly are faced and the hole is finished for the core, which is next assembled in the commutator with suitable insulation between. The commutator is removed from the chuck, and the surface is cleaned up in a lathe. Finally, before being tested for poor insulation, the risers are slotted in a milling machine.

Core laminations are punched out of silicon steel in high-speed presses. A weighted number of them are slipped on the armature shaft and locked in place with a nut. The commutator bars mounted on their core are then pressed over the serrated portion of the shaft. Besides preventing turning, the serrations prevent, through their roughness, lengthwise slipping of the core along the shaft.

Coil assembly is now in order. Insulating paper is first placed in the slots before the coils, previously wound and formed, are dropped in place. They are wedged in place by means of fiber retaining strips driven under the coils. The coils leads are tipped with ferrules and these are now driven to the bottom of the slots in the commutator risers. Soldering follows. Each commutator is dipped in the molten metal, and any surplus solder present is wiped away. The completed unit is then dipped in insulating varnish and baked.

The complete armature is put in a Porter-Cable lathe and the commutator is finish turned. From there, it goes to a special lathe where it is machine undercut. Any insulation left at the inside corners is cleaned out by hand at the bench, after which the commutator is ground in a Cincinnati grinder. This last operation is illustrated in Fig. 5. A Crystolon wheel, 14 in. in diameter by 1½ in. face, is used. Similar grinding operations are performed on the armature core and the two bearing seats.

The ball bearings, retaining washers, and locking sleeves are assembled at the bench. Each bearing has a light press fit on the shaft and is assembled by means of a special swaging tool and an iron-bound rawhide mallet. After assembly, the bearings are inspected and tested.

The field ring or frame of the generator stator is made from lap-welded steel tubing. Close by the railroad siding where the tubing is received is a shed where a battery of Cochrane-Bly cold saws are installed for cutting the rings to length. Fig. 6 shows one of these machines in operation. A ½-ton Shepard electric crane running on an I-beam serves all the saws. The operations of finishing the ends, chamfering them, and finishing the bore and outside diameter are now performed in several steps in a variety of machines, but the use of fully automatic equipment is being tried out experimentally.

A number of drilling operations are performed on the rings. Four holes are drilled and counter-sunk, two at a time, for the pole pieces in an Avey 2-spindle drill press, while ten No. 19 holes are drilled in a Natco multiple drill press. The latter group are afterwards tapped by means of a Leland-Gifford tapping head and 2-flute gun taps. The tapped holes are for fastening the end covers to the field rings, four holes being used for the commutator-end cover, and six for the other. An Avey machine is also used to drill two ½-in. parallel

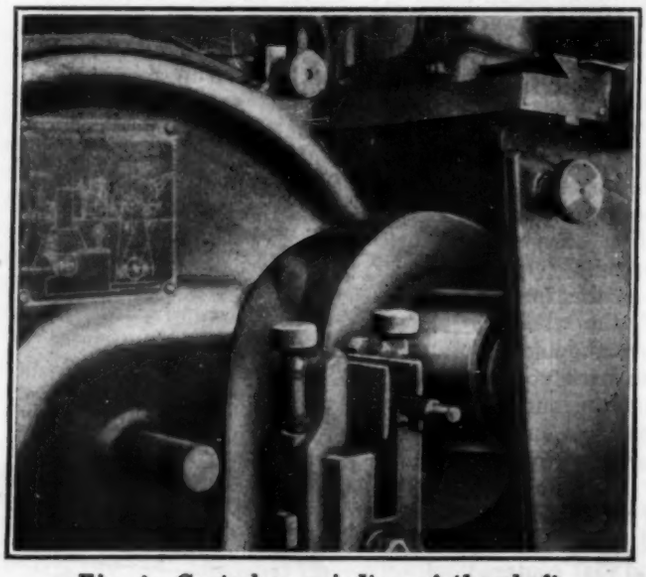


Fig. 4—Centerless grinding of the shaft

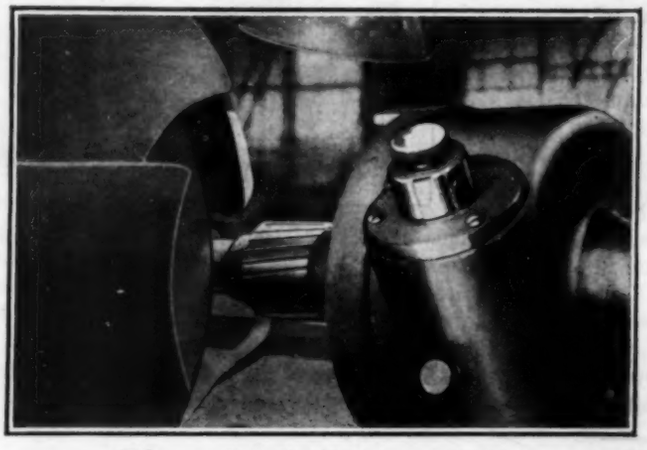


Fig. 5—Grinding the commutator

holes for the fuse block and one 11-in. hole which is afterwards tapped for a dowel pin. Holes 0.078 in. in diameter for fastening the name plate to the field ring are drilled in a smaller machine of the same make, having two spindles set at an angle of about 56 degrees.

All burrs are then removed in a special machine designed for this purpose and the rings are ready to be electroplated. Inspection of bore and outside diameter with ring and snap gages follows. The length between ends is checked by means of an Ames indicator while the piece is held in an expansion arbor on centers.

The drive-end housing and the commutator housing are both made from grey cast iron and are purchased in the rough casting. Annealing in a Frankfort furnace is the first operation on them and it is followed by sand-blasting. In the first machine set-up, the drive-end housing is turned, faced, and rough and finish bored in a Potter & Johnston turret lathe. In the second set-up in the same machine, the front of the flange is turned and faced as is the face of the hub. Fig. 7 shows the first set of operations on this piece. The commutator-end housing shown in Fig. 8, on the other hand, is finished in a New Britain 5-spindle chucking machine. Four positions are used, while the fifth is being loaded. In the first position rough boring, facing, turning and chamfering are performed: in the second, further rough boring and facing: in the third, finish boring and facing: and in the fourth, finish boring, turning, facing, and chamfering. The housing is then reversed and the outside surfaces are turned and faced in another New Britain 5-spindle chucking machine.

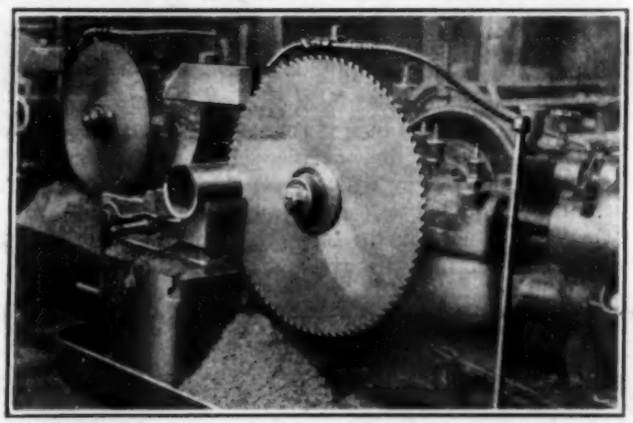


Fig. 6—Sawing seamless tubing for the field frame

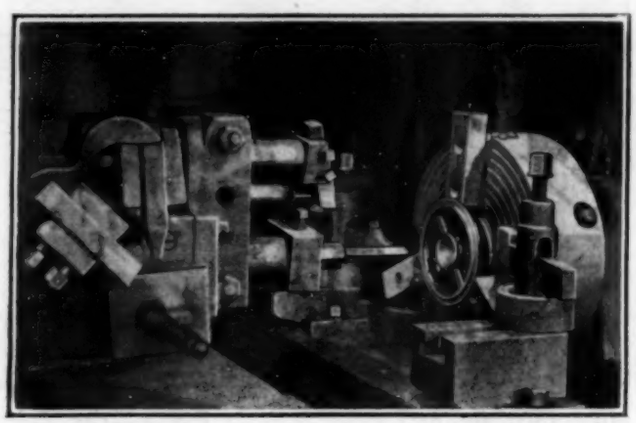


Fig. 7—Turret operations on the gear-end housing

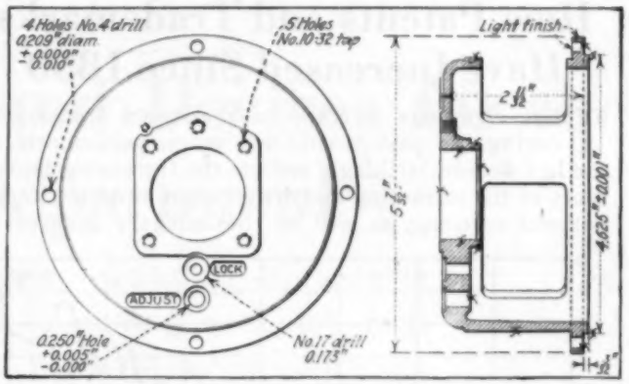


Fig. 8—Commutator-end housing

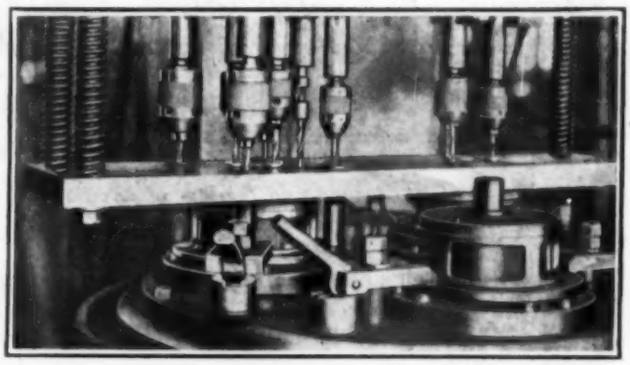


Fig. 9—Multiple drilling on the commutation-end covers

A Natco multiple-spindle drill press, shown in Fig. 9, is used for drilling the eleven holes in the commutator-end cover. Three fixtures are carried on the drill table, which can be indexed. The first station is for loading, while the second and third are for drilling the four holes 0.209 in. in diameter through which the cap screws for holding the cover to the field frame pass; for drilling the five holes, which are later tapped, for the screws that fasten the distributer assembly to the end cover; and for drilling the two holes used to hold and adjust the third-brush carrying frame. These last two holes are spot-faced at the same time they are drilled. Quick-acting clamps and locating pins make the operation of inserting the piece in the fixture a rapid one. Drilling operations on the gear-end housing are also performed on a Natco multiple-spindle drill press. Ten holes are drilled in all, six of them with No. 4 drills for the capscrews that hold the housing to the field ring, and four of them with No. 8 drills. The latter are later tapped for the screws that hold the bearing cap in place. An oil hole is subsequently drilled and tapped in a single-spindle drill press equipped with a tapping head. The oil hole runs into the bearing seat and a groove is chiselled out by hand so that passage is provided for the oil to a point clear of the outside diameter of the ball bearing. An oil-burn finish is then given the housing, and after the surplus oil is scraped off, the bearing hole is reamed clean and gaged. Inspection follows.

The brush holders are made in press operations, after which the pieces are tumbled and then flattened in a Peck drop hammer, which is the crank and leather band type. They are finally zinc plated. Bearing caps and retaining washers are also formed by means of presses, as is the distributor cup, described later.

How Patents and Trademarks Have Increased Since 1850

THE enormous increase in registered trademarks during the past twenty-five years, particularly in the last decade, strikingly reflects the increasing importance of the marketing and distribution problems in our national economy, as well as revolutionary changes in

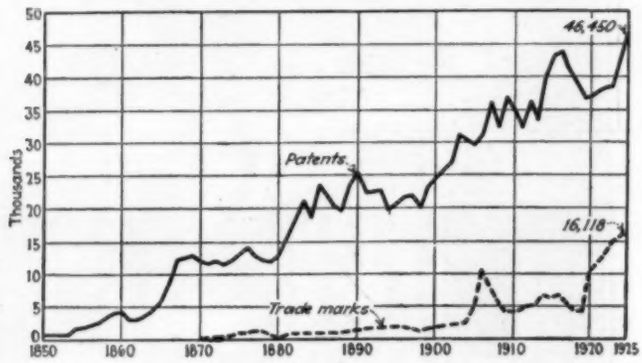


Fig. 1—Patents issued and trademarks registered in the United States

our traditional channels of trade, according to a comparative study of trademarks and patents issued in the United States, made by the National Industrial Conference Board.

While 46,450 patents were issued in 1925, or 88 per cent more than had been issued in the year 1900, the number of trademarks issued in 1925 shows an increase of more than 800 per cent over that of 1900. The reason for the great increase in trademarks is to be found in the modernizing of our system of distribution, in which the trademark, the branding of goods, advertising, chain stores and the mail order business play important parts.

With large scale production and the wide-flung operations of modern selling campaigns in which personal contact is giving way more and more to mechanized and almost automatic distribution methods, the trademark as a protection of branded goods becomes increasingly valuable. With its help, buyers in distant markets identify known products of known makers, and with the less frequent personal contact between buyer and seller, it serves as a guarantee of quantity and quality of a product with which they are acquainted.

In Fig. 1 is shown a chart comparing the number of patents issued and the trademarks registered in the United States during the years from 1850 to 1925, inclusive. The rate of growth since 1900 is shown in Fig. 2. Fig. 3 shows the position held by the United States relative to other countries in the number of patents issued. The development of the machine industry has proceeded at a fairly even pace in the United States and other countries, as the yearly number of patents issued in all countries indicates. The charts show the growth of invention incidental to industrial progress and the growth of trademarks, following the path of organized distribution, to meet the growth of invention.

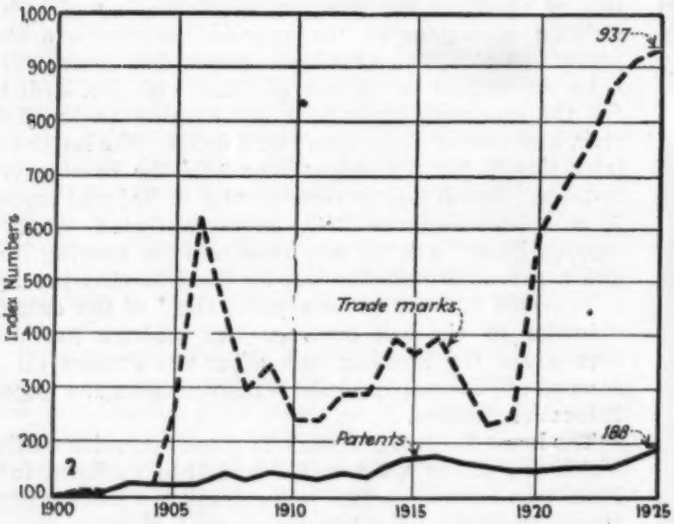
Jigs for Small Jobs

BY R. H. KASPER

Though the time saving effected by the use of drill jigs is generally known, there are many cases, especially in jobbing shops, where the number of like parts to be made is so small that the cost of a jig would not be covered by the saving effected by its use, and therefore the making of a jig would not be advisable.

In cases of this kind it often may be found that one of the pieces may be used as a jig from which to drill the others, assuming that great accuracy is not required. When this cannot be done without altering the piece to such an extent as to render it unfit for service as a part, the value of the piece as a casting may be less than the value of the time saved by its use.

When the junk value of the casting is deducted from its original cost, the sacrifice of one casting may be found to mean very little as compared with the cost of the time required to locate the holes by measurement in the remaining parts. It is therefore advisable when ordering castings to give this point a little serious thought.



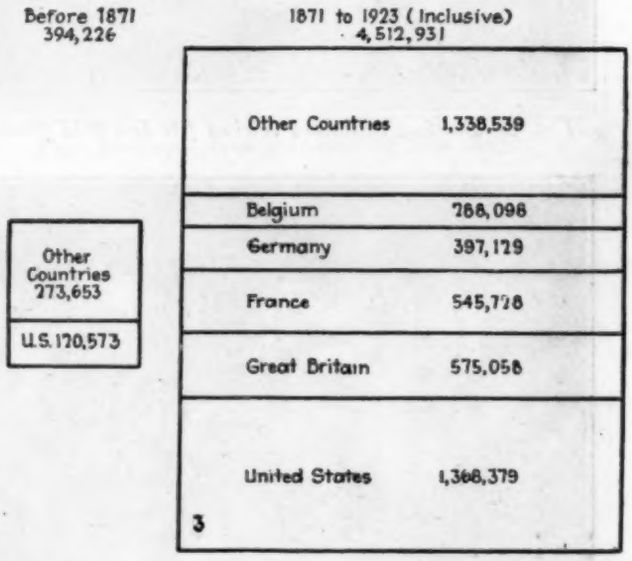


Fig. 2—The growth of patents and trademarks since 1900, in the United States. Fig. 3—The number of patents issued in all countries

Labor-Saving Tools and Devices for the Air-Brake Department

Boring air-compressor cylinders—Lapping slide-valve seats—Reaming triple valves—Cleaning rack for feed valves—Signal-hose stripping device—Miscellaneous tools

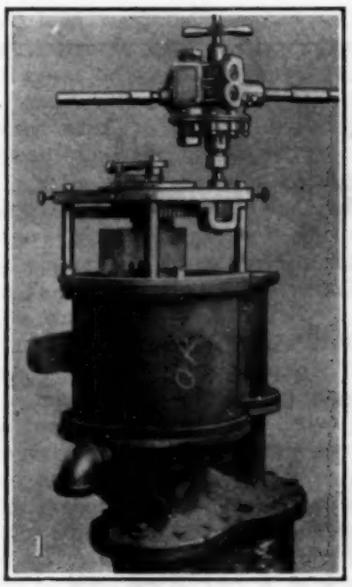


Fig. 1—Boring air-compressor cylinders. Device is attached to cylinder by four studs. Fig. 2—Reaming triple valves. Reamer is guided by bushing screwed into valve body

MAINTENANCE tools for air-brake equipment used in railroad operation are developed usually in accordance with the type of apparatus and prevailing shop conditions. Standardization is difficult since air-brake equipment varies, although the principles employed for one type of equipment can be modified to meet the specific need of other units. The devices illustrated, representing tools used by different railroads, show the advancement that has been made for this class of repair.

In Fig. 1 is shown an attachment for boring air-compressor cylinders. It is attached to the top of the cylinder by four bolts. Thumb screws are used to centralize the upper frame plate, and the projecting end of the bar enters a bushing in the packing box. The boring device, driven by an air motor, has three bars so as to accommodate a variety of sizes. A method of reaming triple valves is shown in Fig. 2. The reamer is attached to an arbor having a square on its shank to fit the holder of the air motor. The other end of the arbor is guided by a hardened bushing that is screwed into the end of the triple valve.

A rack for testing air equipment is shown in Fig. 3. Such pieces of equipment as signal reducing-valves,

From a report compiled by a committee on Labor Saving Tools and Devices for the Air-Brake Department of the American Railway Tool Foremen's Association and presented at fourteenth annual convention, Chicago, September 1 to 3, 1926.

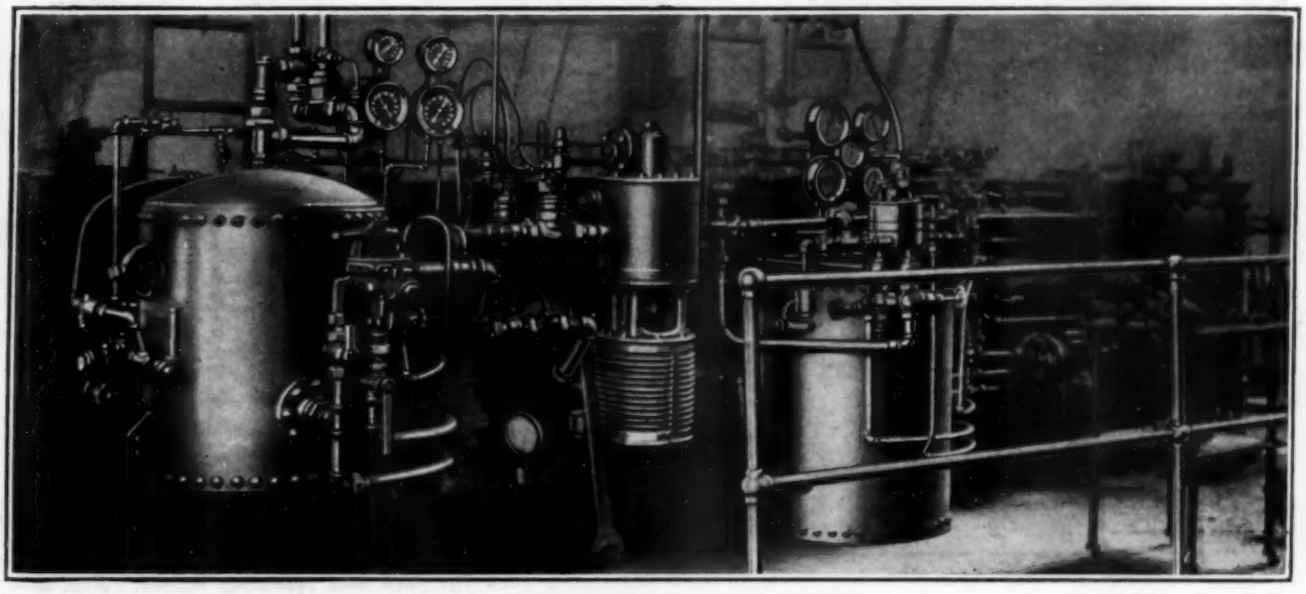


Fig. 3—Rack used in testing air equipment

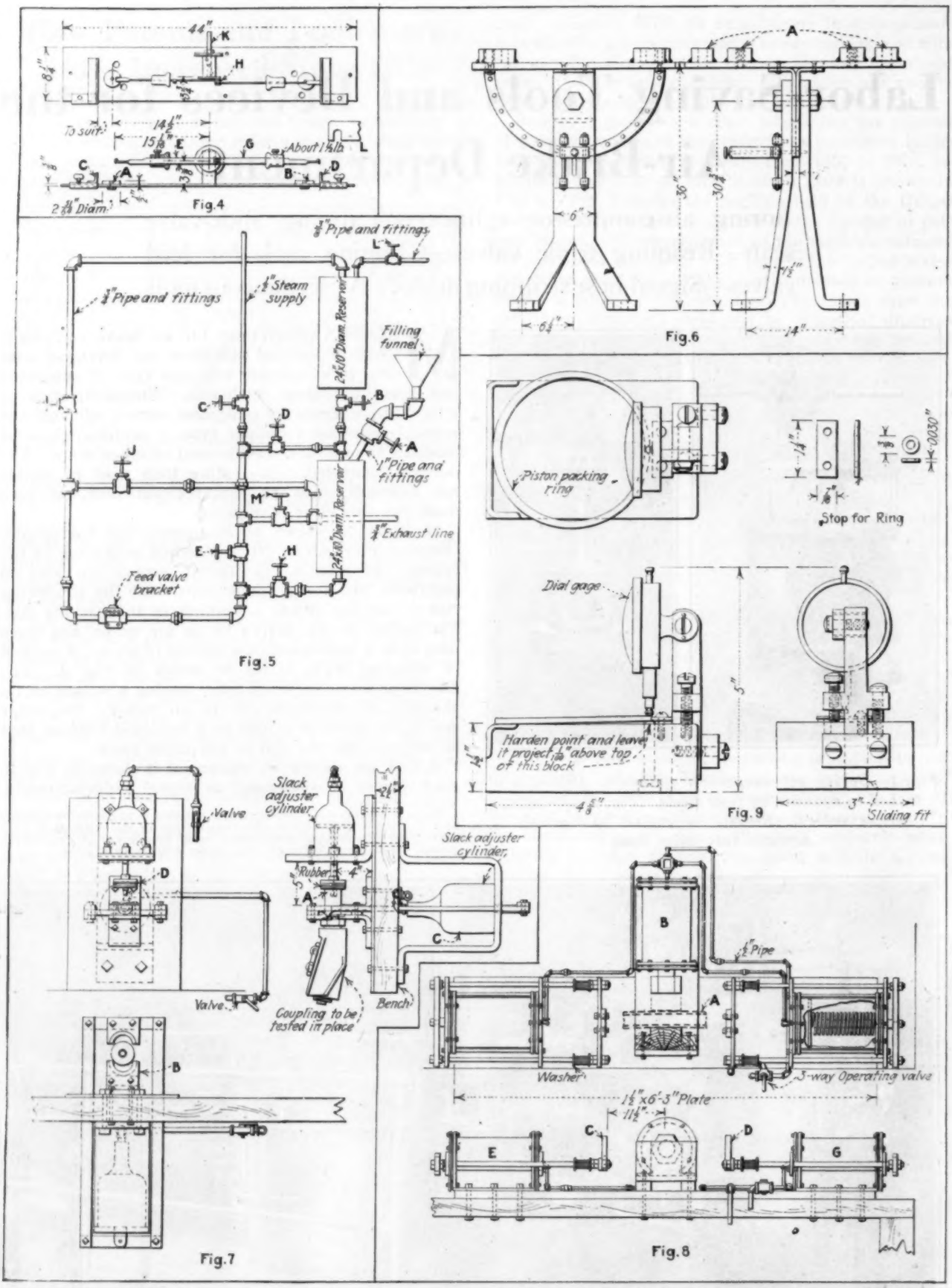


Fig. 4—Device for lapping slide-valve seats. Fig. 5—Cleaning rack for feed and reducing valves. Fig. 6—An adjustable air-pump repair stand. Fig. 7—Testing steam-hose couplings. Fig. 8—Air-brake and signal-hose stripping device. Fig. 9—A dial for testing piston packing rings

checks and strainers, automatic brake-valves, automatic brakes, independent brake-valves, distributing valves, safety valves, high-speed reducing valves, and steam reservoirs are tested. An air pressure at 80 lb. is carried in the tank shown at the left, while in the tank on the right, serving as a main reservoir, the pressure is 130 lb. Air units are given a service test.

The device shown in Fig. 4 is used to lap slide-valve seats of triple valves. Two triple-valve bodies are placed on the plugs *A* and *B*, after which the slides *C* and *D* are adjusted to the bodies and locked by thumb screws. The slide valves then are assembled in the bodies. The rods *E* and *G*, driven by the crankpin *H*, are attached to the slide valves so that when the shaft *K* is revolved, an oscillating motion is obtained. Adjustable lead weights, mounted on the rods, can be set lengthwise to suit the pressure required. Either an air motor or a rope drive can be utilized. The ends of the rods, connecting with the crankpin, are made as shown at *L* so that either side can be disconnected without disengaging the drive.

In Fig. 5 is shown a cleaning rack for feed and reducing valves which is operated as follows: Dissolve three or four cans of lye in one or two gallons of water and pour the mixture into the bottom reservoir through the funnel. Then fill the remainder of the reservoir with water and close valves *A*, *B*, *E* and *H*. Then attach the feed valve to the bracket, keeping the same tension on regulating spring. Open valves *H*, *K* and *L*, allowing the solution to pass from the bottom of the reservoir through the valve *H*, the feed valve, and the valve *K* into the top reservoir. Valve *L* is used only as a relief valve to prevent the building up of back pressure in the top reservoir and to stop the flow of the solution. After the solution has passed from the bottom to the top reservoir through the feed valve, close valves *D*, *H* and *K* and open valves *E* and *J*, allowing the dry steam to pass through the feed valve and through the valve *J* to the outside of the building. Close valves *E* and *J* and open valves *A* and *B* to allow the solution to pass from the top reservoir to the bottom reservoir. Valve *M* is applied in draining.

An adjustable air-pump repair stand is shown in Fig. 6. The work, clamped on the surface *A*, can be swung at a right angle from the position shown for accessibility of repair. A device for testing steam-hose couplings is illustrated in Fig. 7. The work shown at *A* is held in the fixture by the clamp *B*, which is operated by a plunger in the cylinder *C*. A similar cylinder operates the plunger *D* which seals the open end of the coupling. Air applied to the opposite end of the coupling will show any imperfections. Using air pressure at 90 lb. will show small fractures that are not usually detected if the hose is tested by steam pressure, since the heated metal has a tendency to expand and temporarily close the cracks. In Fig. 8 is shown an air-brake and signal-hose stripping device. The hose is inserted as shown at *A*, and is clamped by admitting air to the cylinder *B*. The fittings of the hose are attached to the hook plates *C* and *D*, attached to piston rods in the cylinders *E* and *H*. By admitting air to the front ends of the cylinder *E* and *G*, the hooks are forced in opposite directions and fittings are stripped from the hose.

A dial gage used in testing irregularities in the width of piston packing rings is shown in Fig. 9. In Fig. 10 is shown a press for closing the ring grooves of equalizing pistons. The support plate *A* is placed under the piston *B*, then both units are inserted into the device through the open end *C*. The ram *D* strikes the top of the piston and closes the ring groove an amount sufficient to render the piston suitable for further use.

A stand for holding triple valves while undergoing repairs, and in having the piston rings lapped, is shown in Fig. 11. The valve is clamped to the plate *A* which in turn is mounted to a bench so that it overhangs as shown. Lapping is accomplished by operation of the lever *B* attached to the piston ring holder *C*. For repair work on other parts the lever is thrown in a downward position.

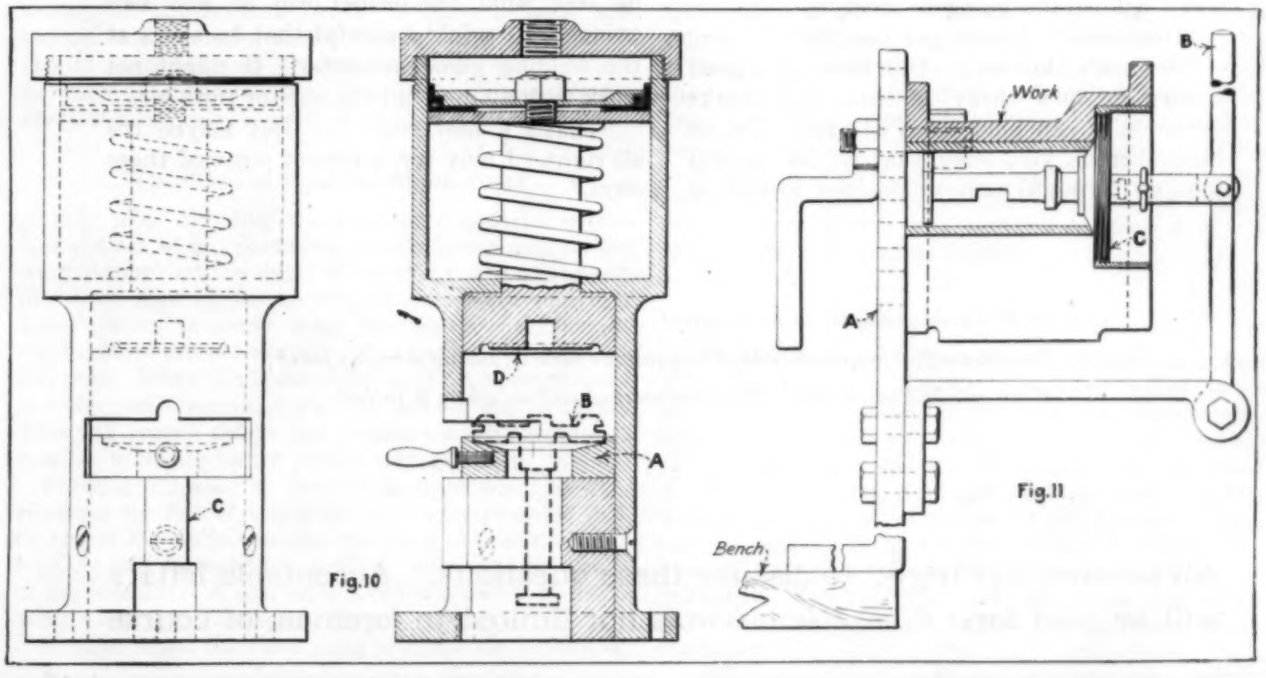


Fig. 10—Press for closing piston-ring grooves. Fig. 11—A triple-valve repair and lapping stand

THE · FOREMAN'S · ROUND · TABLE

More About Discipline in the Shop

The following narrative is a "case" presentation of the topic. It has been written to involve some of the questions that arise in the average shop. For guidance in preparing discussion the questions at the foot of the page have been prepared

"SAY, Al, what's the idea of putting Bill Jones on that rough filing job?" asked Ed at lunch one day. "He's supposed to be a good welder—and here you go and put him on a boy's job. Pretty hard on the company's bank account, isn't it, Al?"

"You haven't told but half of it, Ed! Did you see the youngster at the next bench doing the welding? Well, he is and he's doing a good job, too. No, I haven't forgotten the firm's bank account at all and I figure I'm saving them money in the long run, though it may not look so. I'm just trying a new kind of discipline on Bill Jones and I believe it's going to work."

"Discipline? I don't get you, Al."

"Well, it's this way. Bill Jones is a good welder but he's 'cocky' at times and thinks no one else can hold down his job. Got so cantankerous yesterday that he let several jobs go through with welds that looked as though they were done by a rank amateur."

"Why didn't you fire him?"

"Firing isn't always the best way, Ed. He's a good man when he wants to be and worth money to the company. So this morning I gave him that filing job and put his helper on the welding. And he's doing a good job. Bill isn't happy to be filing right beside the kid who is doing his job. But I'll bet he'll do the best welding tomorrow that he's ever turned out. He gave me a sort of sickly grin a while ago and he knows darn well why he's filing today. Then, too, he sees what the helper can do and he's going to be mighty careful that he stays at the welding game hereafter. It might not work with all men but I'm sure of Bill Jones."

"That's a new one, Al. But maybe it's all right. I may try it myself some of these days."

Is Al's plan workable in most cases?

Does it conflict too much with Al's previous idea of saving a man's face?

Have you had cases where Al's plan worked well or where it failed?

All foremen are urged to discuss these questions. Acceptable letters will be paid for. The discussion is not limited to foremen, of course

Discussion of Earlier Topics

Getting Information from Catalogs

TO MY way of thinking Al is on the right road when he believes that many advertising booklets are valuable. Ed is also right in saying that they are good instruments for selling machinery. But if a catalog describes a machine that Ed can use in his department and which will pay for itself through its savings over the old tool, hasn't the catalog justified itself as a bit of educational matter?

No one knows the faults of a machine any better than the builder. It sometimes takes considerable experimenting on the part of the builder to overcome some difficulties in connection with his products. These may be problems such as the proper tooling of the machine, the proper cooling compound to give best results and the speeds and feeds which will allow maximum production without burning the tools.

Why should Ed go through all this experimental work again, when he can benefit by the builder's costly experience. Then, too, the builder spreads the cost of his experimental work over a large number of machines so that the share which each machine must carry is comparatively low. But the experimental costs that Ed will have must be borne by the single machine on which he makes them, and will be higher.

Ed had better think over the difference in cost between his experimental work on speeds, feeds and tooling, and the experimental cost that the builder carries in developing his products. If the shop in which he works belonged to Ed he would probably modify his views to some extent.—JOS. E. ABBAZIA, *Mech. Instr.*

Who Should Boss the Move Men?

ODD jobs, including the moving of material within and out of a department, seldom give a man steady work throughout the day. When many jobs are ahead, the move man or handy man is overloaded and this often results in costly delay for the machine hands. Again, there are periods when he has nothing to do but kill time. When the transportation for all departments is under one foreman, a working balance can be found. This will reduce delays and loafing periods, making it possible to secure better results with less help.

Foreman Ed must be terribly dignified when he worries over the loss of a helper. It is very probable that by giving his mechanics the time used to boss the move man, he will increase his contribution to the dividends of his company. A part of this contribution is likely to find its way into Ed's pay envelope.

In some shops the move gang is under the control of the planning board operator. Under this system, every job moves to the next operation immediately after the preceding one is reported finished. All parts will be moved more promptly if attended to by men who are systematically organized to handle the job.—LAWRENCE F. SWENSON, *Standards Engineer.*

Getting Information from Catalogs

CATALOGS which contain the most complete information about the machines which they describe, and the tools and work that the machines will accomplish, are the best for the shop man. It is no uncommon thing for the foreman to refer to catalogs for information in regard to both the machines and the methods of tooling. Whenever possible, the illustrations should show the machines at work.

I have often referred to catalogs when making small or special tools for the shop, and I have noticed that most foremen take care of the catalogs which come to their hands, so that they can be used for future reference. It is not possible to get all the information that is contained in the catalogs from a text book even though the text book is indispensible to the shop man.

The function of the catalog, undoubtedly, is to impress a prospective buyer of the superiority of a machine, but it does this by giving information as to the construction, handling and capabilities of the tool. The catalog should also state the kind of labor, skilled or unskilled, juvenile or adult, that is required to handle the machine. It should illustrate typical jobs that the machine has been used for and should state the time required to do the job. These typical times should be understated rather than overstated for there will be a better psychological reaction on the foreman who can beat the catalog time.—H. MAPLETHORPE, *Foreman, England.*

Teamwork in the Shop

A HELPING hand is appreciated although not always acknowledged. Whether the other fellow is individually responsible for the erecting department's being behind in its output or not, we are all members of the organization and morally obligated to each other. A determined desire to stand ready to assist another department is very important to the success of your organization. Running a factory on the "every-man-for-himself" plan does not conform to American ideals and principles. The mule who pulls off to one side of the road cannot be endured.—STORRS T. RICHMOND, *Master Mechanic.*

THE · NEXT · TOPIC

Why They Didn't Use a Jig

QUESTIONS

Do jigs always save time?

Did you ever know a case where they didn't?

Or where the workman wanted a higher price rate if he had to use a jig?

Ideas from Practical Men

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the metal-working industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

Modeling Clay in the Drafting Room

BY JOHN F. HARDECKER

Jack Brown and Bill Smith, chief draftsmen, were having their weekly luncheon together. Jack was telling of the difficulties he was having in developing some of the intricate machined fittings on his Toledo job. "You see," said Jack, "I'm using new men on this job, who are none too familiar with this class of work and consequently are none too sure of themselves. If I didn't have the best of my old men on that rush Victor job, I'd be all right, but as it is, I have to spend a lot of time personally with the new men, to be sure they're on the right track."

"Well," replied Bill, "remember my telling you of my visit with our old friend Ed Jones out at the Eagle Aircraft Company? I don't know of anything that can get more complicated on occasion than an airplane fitting, and while there I saw one of his men using modeling clay. He shaped up his fitting in clay in the short time I was there, showed it to Ed, and got his approval, and then started to detail it. Ed also told me they use the same piece of clay over and over again. Why wouldn't that be a good stunt for you, too, Jack?"

"You bet," said Jack, "where can I get some?" "At any art supplies store," replied Bill. And at their next luncheon, Jack reported the success of his new idea.

Painting Graduations Accurately

BY DOUGLAS L. PARKHURST

The spaced checker work graduations on the leveling rods used by the United States Coast and Geodetic Survey must be made with an accuracy of plus or minus one millimeter per kilometer, or approximately $\frac{1}{16}$ in. per mile. To obtain this fine degree of accuracy in the painting, the machine shown in Fig. 1 has been designed.

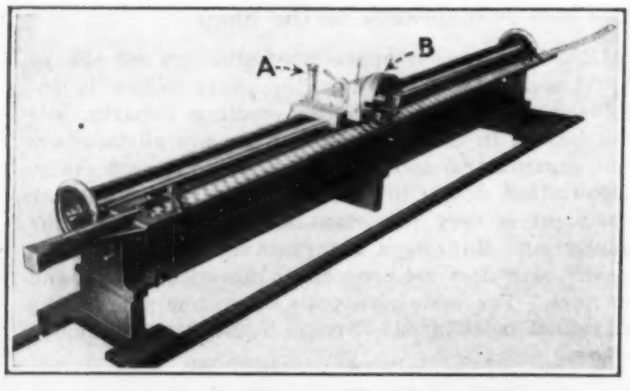


Fig. 1—Accurate graduating machine

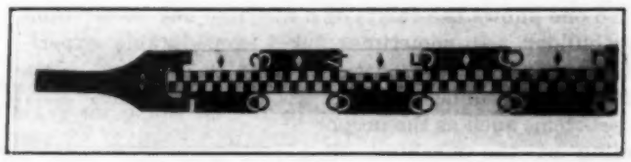


Fig. 2—Checker graduations on the leveling rod

The leveling rod is illustrated in Fig. 2. It is a thin strip of Invar, an alloy unaffected by ordinary changes in temperature, rigidly attached to a hardened cast-steel footpiece and supported by a wooden backing piece. The strip is given a base coat of white enamel before the black checker work is applied.

The machine consists of a bed similar to that of a large bench lathe, upon which a carriage slides in dovetailed ways, being actuated by a lead screw engaging with a half nut mounted in the carriage. For rapid traversing, the half nut may be lifted clear of the screw by means of an eccentric, and the carriage moved by hand.

Necessity for accuracy of lead in the screw has been eliminated by making use of the comparison method of spacing. A bar of Invar, of the same physical characteristics as that used in the strip, which has been accurately ruled to 1-cm. divisions, is fitted into a groove in the rear of the bed, being held in place by a screw at one end so that the bed may expand or contract without affecting it. The carriage is fitted with a small microscope, *A*, having fine parallel wires of tungsten at the focal plane. These wires straddle the ruled line on the bar when the carriage is in the proper position for painting. A small electric bulb illuminates the bar so that the two wires appear as sharp black streaks with the graduation on the bar as a brilliant line between them. Setting the carriage correctly is rapid and easy.

The mask, *B*, is in the form of a cup with four rectangular slots of the proper width cut in the rim. It is mounted on a large bearing on the vertical slide, and may be turreted, so that accumulations of paint may be removed without interrupting the work.

The vertical slide may be raised or lowered by a small lever and eccentric, which presses the mask firmly against the work or lifts it when the carriage is to be traversed. These parts are mounted on the cross-slide of the carriage, and permit centering of the lines of checker work.

Painting is done by means of a small air brush, using a quick drying black paint. Since the mask is lifted

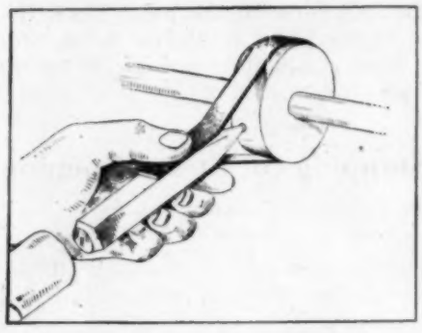
vertically, however, it is not necessary to wait for the paint to dry before moving to the next square.

Rods painted with this machine are far more accurate than are those done by hand, and are more satisfactory to the observer, since the lines of demarcation are straight and sharp. The time consumed in graduating is about one-half that required by the former method.

Catching Taper Pins

By H. Moore

Taper pins have a nasty habit of flying out when they are struck on the small end. In the majority of cases this does not matter much, since the pin is easily caught, but if part of the machine is being torn down, the pin is liable to fly somewhere where it will be difficult to find it. For this reason, or possibly to save a window from being broken, or the sight of a fellow workman from being injured, something should be used to catch the pin as it leaves the hole. The device illustrated will do the work in a satisfactory manner. I use a driver made from square stock and ground on the end in the usual manner. It affords a better gripping surface than does a round driver, especially when used in conjunction with a leather strap which for handiness should be riveted to one side of the tool.



Device for catching taper pins

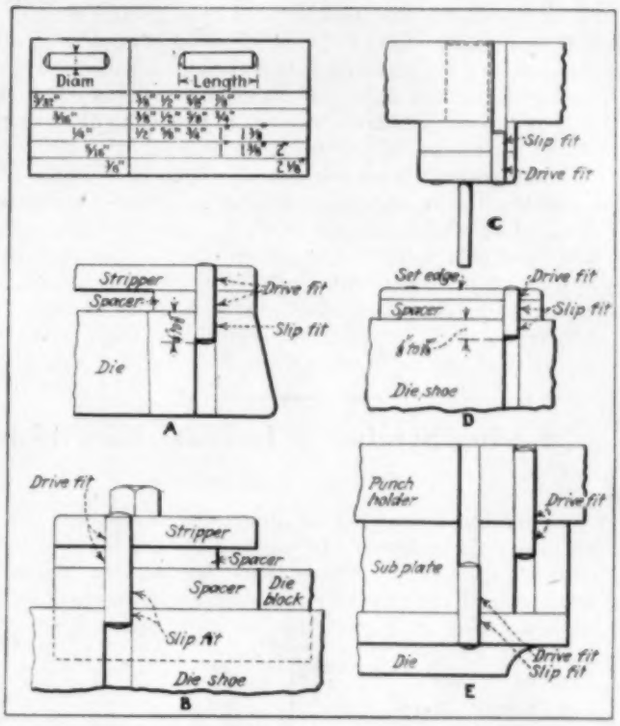
Before driving out the pin, the loose end of the strap should be wrapped around the piece, drawing it tight and holding it against the other side of the driver with the thumb.

Standardized Dowel Pins for Die Construction

By George H. Feltner

In a mid-western plant where a considerable quantity of press tools is employed, it was deemed necessary to standardize the dowel pins used in die construction. When the dimensions of dowel pins were left to the individual designer or diemaker, a variety of sizes were used. The function of a dowel pin is important and if it is made too short or too long, its value is lost. The question of where the pin should be a drive fit and where it should be a slip fit, also presented itself.

After experimenting with different styles and sizes of pins, the dimensions and proportions shown in the illustration were adopted as standard. The table shows the diameter and the length of the pins recommended. Variations from these specifications are permissible only in special cases, and for large sized dies. At *A* is shown the proportions of pins for small blanking dies. The pin is a drive fit in both the stripper and the spacer, and a slip fit in the die. In blanking dies of the pillar type, the pins are assembled as shown at *B*. In mounting punches of drill rod, the hole for the pin



Dowel-pin dimensions for press tools

is drilled through the punch holder as shown at *C*. Set edges or nest plates and spacers of piercing dies have their dowel pins assembled as shown at *D*. Compound dies, equipped with subplates, have two sets of pins as illustrated at *E*. If one pin were used to join the three units, there would be a possibility of the pin becoming sprung, resulting in a misaligned assembly.

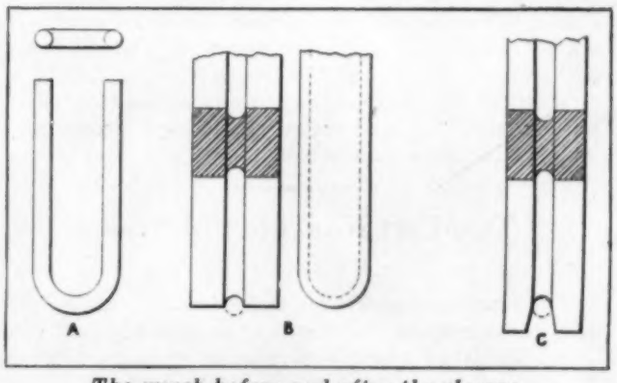
Correcting Trouble in a Bending Punch

By R. H. Kasper

A punch and die was to be made to bend ¼-in. round stock to the shape shown at *A* in the sketch. Since the order was a small one, the allowance for tools was accordingly small, but the apparent simplicity of the job did not cause us to worry on that account.

The punch was made as shown at *B*, by rounding one end of a piece of flat steel to the proper radius to produce the bend, and making a half-round groove in it of a radius equal to that of the stock. The die consisted of two blocks, similarly grooved, between which the stock was pushed by the punch.

When these tools were tried, however, we found that



The punch before and after the change

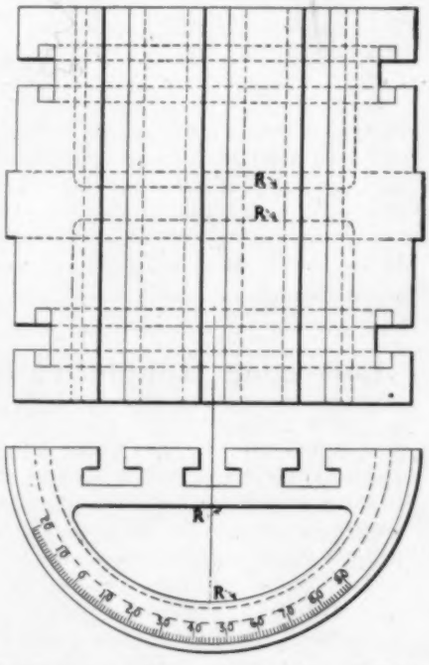
there would be considerable variation in the length of the two ends. Since the stock was of uniform size throughout, we attributed the trouble to slight differences of surface finish at various points, causing one side of the stock to draw more easily into the die because of the difference in frictional resistance.

After several unsuccessful attempts to remedy this condition the trouble was finally overcome by making the end of the punch as at *C*, the groove being made deeper at this point and of slightly less radius than that of the stock. The sides of the groove were steeply tapered, causing the stock to wedge tightly in the groove so that it could not slip either way, with the result that the sides were drawn evenly.

Drawing Symbol to Indicate No Finish

BY JOHN HOMEWOOD

In making a drawing of a part that is to be finished all over it is customary to use the symbol FAO to indicate the condition. Where there are but few places to be machined the symbol *f* is placed on those parts. But on a drawing of a part that is to be finished all over with the exception of a very few places, the task of placing the finish marks becomes so tedious as to raise in my mind the question why not have a symbol (*R*) to designate the places that are to be left in the rough? To illustrate the condition stated above: In the accompanying sketch of a tilting table, which for this purpose is devoid of all trimmings, such as dimensions, etc., the placing of finish marks on all finished surfaces would be quite a job, whereas if the recommended symbol *R* were placed as shown and a note placed below the drawing to read "finish all over except where indicated," or "*FAO*, except *R*," would not the information be properly conveyed?



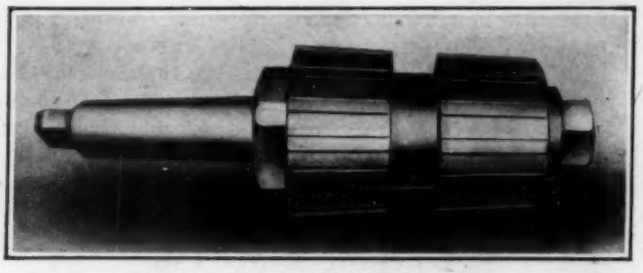
Drawing symbol to indicate no finish

When it comes to adding to our already established conventions, I am a conservative, but even a conservative must yield to the pressure of necessity.

Two-Part Knuckle Pin-Reamer

BY J. MADDEN

For reaming knuckle-pin holes in side rods, the two-part taper reamer illustrated is used in the Las Vegas, Nev., shops of the Union Pacific System. The two reamers are mounted on a piece of round stock and with



Two-part knuckle-pin reamer

a taper shank. Between them is a collar, and the three pieces are held together against an upset portion of the shank by a collar and nut.

The advantage of this tool is that collars of different widths may be placed between the reamers to bring them closer together or hold them farther apart, the result being to control the relative amounts of increase of diameter of the two bores in the rod. Thus, if it happens that one of the bores is unduly worn, while the other is not worn at all, it is possible to set the reamer to just clean up both.

Devices for Stopping-Off Steam Openings

BY CLYDE D. THORBURN
Montreal, Canada

The illustrations show devices for blanking off various openings in locomotive cylinders, previous to testing for leaks in the castings.

The device in Fig. 1 is for the face of the live-steam connection *A*. The fingers *B* engage in slots cast in the sides of the connection. Pressure is applied

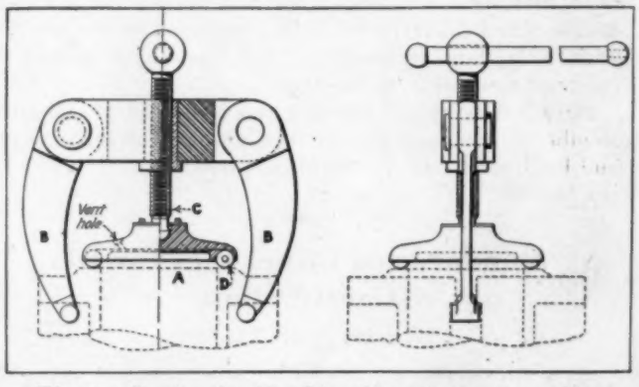


Fig. 1—Device for blanking live-steam connection

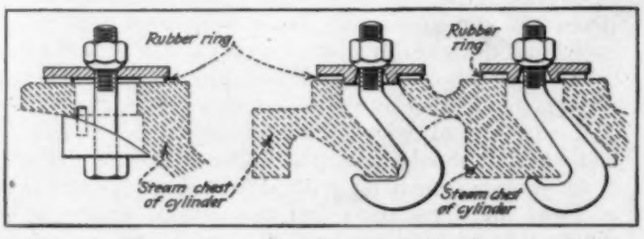


Fig. 2—Devices for blanking relief-valve openings

by the screw *C*, and the joint is made tight by the gasket *D*, made of heavy rubber hose, and placed in a groove in the cover plate. The opening for the exhaust is blanked by a similar but somewhat modified device.

Three types of devices for blanking the openings for relief valves are shown in Fig. 2. The methods of their application are obvious and need no explanation.

Characteristics of Alloy Steels

High-Speed Steel

High-speed steel is the generally accepted name for the alloy tool steels containing a high percentage of tungsten and varying percentages of other elements to suit the requirements of the work. High-speed steel is employed for cutting tools, especially lathe and planer tools, drills, and milling cutters.

The tungsten imparts to the alloy the property of retaining its hardness and cutting edge when red hot. Small percentages of chromium, vanadium, cobalt, and other elements are intended to give the alloy certain additional characteristics such as homogeneity, toughness, and the ability to retain a fine cutting edge. The usual specification for high-speed steel calls for 18 per cent of tungsten.

Standard high-speed steel is made either by the crucible or electric-furnace processes, and is furnished by the makers annealed unless otherwise specified. The permissible variations in composition above and below the specifications as allowed to the manufacturer by the A.S.T.M. standard specifications are shown in Table 1, and in Table 2 are given the maximum tolerances in dimensions.

The commercial high-speed steels may be classed for convenience as "high-tungsten, low-vanadium," "low-tungsten, high-vanadium," and "high-tungsten, cobalt." An examination of a number of the analyses of the high-tungsten steels shows tungsten contents within 1 per cent above or below 18 per cent, while the low tungsten steels average 13 per cent of tungsten. The manganese content varies from 0.12 to 0.42 per cent, the chromium from 2.95 to 4.37 per cent, and the vanadium from 0.68 to 1.99 per cent. Some of the commercial high-speed steels contain small percentages of molybdenum. Other alloying metals in small proportions are sometimes added, giving the high-speed steel the nature of special steels for special purposes. The carbon content usually varies from 0.60 to 0.70 per cent.

High-speed steel containing 18 per cent of tungsten is annealed by heating slowly and uniformly to a temperature of 1,600 deg. F., holding at this heat for a period to permit complete adjustment of grain, and then cooling in a furnace or in lime or other material that will assure uniform slow cooling. Cooling in air is likely to result in a partial hardening of the steel, and is unsatisfactory.

The A.S.S.T. recommended practice for heating in the hardening of standard 18 per cent high-speed steel is as follows: Preheat slowly and uniformly to 1,500 deg. F. in an open furnace of sufficient size, and not in a lead or salt bath. Then transfer the preheated steel to a high-temperature furnace, which is maintained at a temperature of from 2,250 to 2,400 deg. F., depending on the type of tools being hardened. Some of the makers of steels containing cobalt, however, recommend a higher temperature.

In order to obtain the best "red hardness" conditions, the steel should be brought rapidly to the higher temperature, but in many cases the character of the cutting edges of such tools as milling cutters makes it inadvisable to use the higher temperatures owing to the destruction of the delicate edges by blistering or pitting. The higher temperatures are employed for hardening rough lathe tools.

High-speed steel tools should not be held at the high temperature, because of the fact that these temperatures cause excessive grain growth and subsequent brittleness of the hardened steel. Tools that cannot be ground after hardening are often heated in a bath of barium chloride or other salt.

For hardening high-speed steel, it should be quenched in oil or cooled in air. The oil quenching bath is usually maintained at a temperature of from 150 to 200 deg. F. in order to minimize the danger of breaking intricately shaped tools.

In tempering high-speed steel tools after hardening they are reheated uniformly in an open furnace, or in a lead bath or sodium nitrate bath, to a temperature of from 1,050 to 1,150 deg. F., and then cooled in the air. Careful heat-treatment is essential.

Table I—A.S.T.M. Standard Permissible Variations in the Composition of High-Speed Steel

	Variation, Per Cent Over	Under
Carbon	0.05	0.05
Manganese	0.15	0.15
Phosphorus	0.01	....
Sulphur	0.01	....
Silicon	0.15	0.15
Chromium	0.50	0.50
Vanadium	0.25	0.25
Tungsten	0.75	0.75
Cobalt	0.50	0.50

Table II—Standard Tolerances in Dimensions of High-Speed Steel Stock

Forged and Rolled Stock	Variation, Over	Inches Under
½ in. or under	0.010	0.010
½ in. to 1 in.	1/64	1/64
1 in. to 1½ in.	1/32	1/32
1½ in. to 2 in.	3/64	1/32
2 in. to 4 in.	1/16	1/32
4 in. to 6 in.	1/16	1/32
6 in. to 8 in.	1/16	1/16
Over 8 in.	1/8	1/16
Finished Stock, Drill Rod		
7/16 in. or under	0.0005	0.0005
Over 7/16 in.	0.001	0.001

For the information given we are largely indebted to the A.S.T.M.

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Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

Pitch and Lead of Multiple Threads

Q. We received a blueprint from a customer calling for a "square thread, double thread, ½-in. pitch." We made the screws according to the drawing, but our customer comes back saying that the thread should be ½ in., center to center. Our idea of pitch is the distance from the center of one thread to the center of the other, whether single or double. We chased these screws 1¼ in. lead, ½ in. pitch. Is this not according to the blueprint?

A. We believe that you are correct in your interpretation of the blueprint. The pitch of a screw is always 1 divided by the number of threads per inch, or the pitch in inches is the distance from the center of one thread to the center of the next. The lead of the screw is the distance that the thread advances in one revolution of the screw, and in the case of a single-thread screw the lead and the pitch are identical. In a double-thread screw the pitch is one-half of the lead.

We note that the English handbooks entirely omit the word pitch with multiple threads, and designate the lead only. Either this should be done, or both should be given on drawings of multiple screws, as this will eliminate all cause of confusion.

Saving Spoiled Parts

Q. We have a lot of 3,000 nickel-steel forgings in which a 0.125-in. hole has been drilled about 0.015 off center. We are anxious to save them as the machine work already done on the pieces amounts to a considerable item. Do you think that it would be advisable to fill the hole by welding and then re-drill?

A. This is a comparatively simple operation. Fill the holes by using a low-carbon steel welding rod, and anneal the pieces afterwards. In the annealing process enough of an equalization will take place between the added metal and the original forging so that the drill will not run off in the drilling operation.

Starting a Safety Competition

Q. We are anxious to start an interdepartmental competition in our safety campaign. Can you suggest methods that have been successful in other plants? We already have a fair program on the matter of safety rules, but are considering the giving of prizes.

A. We will start with a word of caution to the effect that interdepartmental competitions, unless most carefully supervised, can easily be overdone, and besides causing unfriendly feeling, are apt to absorb too much attention away from the real work at hand.

In rating accidents in a competition contest mere number of accidents is not sufficient for consideration, and you will find that in order to avoid continual discussion you must take into consideration the severity of the accidents, and the conditions surrounding the department. It is obvious that a punch press department will have more frequent and more severe accidents than an assembling room where no machinery or belting is in use.

An arrangement of comparison of the severity rate between departments having widely varying conditions is bound to be arbitrary and unsatisfactory where prizes are offered. A somewhat better scheme is the "time lost" method, which includes all the time lost by employees due to accidents, to which may be added time lost through sickness if so desired.

We are of the opinion that interdepartmental prizes for safety work should not ordinarily be resorted to unless other methods fail. At best it is likely to have only a temporary effect, and be the cause of bad feeling. A better plan might be to offer an annual prize, of possibly a holiday with pay, to the whole plant as a reward for a reduction in the number of hours lost through accidents, the standard time lost to be based on a previous year's record. In such a case a friendly rivalry would probably be found amongst the different departments to show in a general way that they were each doing their share. At the same time it eliminates bitterness arising from a feeling that one department has harder problems to solve than another.

Welding Rod for Cast Iron—Discussion

By J. F. Lincoln
Vice-President, The Lincoln Electric Co.

With reference to the question on welding rod for cast iron on page 724, Vol. 65, of the *American Machinist*, the great difficulty in welding this metal with steel or with cast iron, as is frequently done, is the fact that the rates of contraction of the cast-iron parent metal and the added metal are not the same. Consequently, while the weld may be perfect when it is hot, it is apt to break at its point of weld when it cools, because of the unequal shrinkage.

It is necessary in the welding of cast iron to use some kind of a filling material that will change its shape; in other words, something that is not as rigid as the cast iron itself, and also something that will unite with the cast iron in a real weld. There are two metals that do this to good advantage; one is copper, and the other is nickel, or alloys carrying a very high percentage of these metals. Either of these metals applied as a metallic electrode, or preferably by the use of the carbon electrode, will make a cheap and reliable weld. It is impossible to weld cast iron in general by the use of a steel electrode. It may look like a weld, but it has not really united.

Technical Abstracts

Research Work at Bureau of Standards

With the reservation that further work or full details might modify statements that may appear too sweeping because of their brevity, some of the interesting points recently found in work of the Bureau of Standards as yet unpublished are given below.

In tests made in a new type of testing machine designed and constructed at the Bureau, on wear of gage steel, chromium-plated plug gages were found remarkably superior in resisting metal-to-metal wear, while some file-hard gages appear less resistant than those of corresponding steels treated so that they can be touched with a file.

The study of "abnormal" carburizing steel shows that the aluminum content, spectroscopically determined, has a marked relationship to the degree of abnormality, though it is more likely concomitant with the real cause of abnormality rather than itself the actual cause. The content of dissolved air in water used for quenching has a marked bearing on the prevalence of soft spots in the case.

Up to one per cent of tin appears to be harmless in high-speed steel as far as performance in roughing cuts goes, though other properties may be injured. Nickel up to 3 or 4 per cent makes a high-speed steel require a higher hardening temperature, but does not injure performance. It makes the high-speed steel itself difficultly machineable in the annealed state, but if the carbon content is reduced from the customary 0.65 per cent, this is overcome while the good performance is still maintained.

The relative machineability of alloy steels, in roughing lathe cuts, varies with the hardness at which the steels are compared. At low hardness chromium steels are less readily machineable than carbon or nickel steels At high hardness nickel-chromium and chromium-molybdenum are more readily machineable.

Longtime "creep" tests at high temperatures indicate that the load-carrying ability of some high-chromium steels is not as good at temperatures of 1,100-1,350 deg. F. as that with which they are usually credited. If a suitably sensitive extensometer is used in the short-time tensile tests accurate determinations of proportional limits at high temperatures give, on several types of steels, useful approximations of the load-carrying ability. Apparatus measuring strain to four millionths of an inch, which was designed and constructed at the Bureau, is used.

An alloy of iron containing about 13½ per cent vanadium and 3 per cent carbon, made into Brinell balls and suitably heat-treated, shows only about half as much flattening during the Brinell test as an ordinary ball and about the same as the Hultgren work-hardened ball. The balls can be work-hardened, after which they show only half the flattening of the Hultgren ball. A steel reading 650 Brinell with a Hultgren ball will read 695 with the work-hardened vanadium ball.

As much as 300 per cent variation may be found in determinations of scratch hardness by the "micro-character" made by different observers, and they may even class materials in a different order of hardness. The method is useful chiefly as a rough approximation when no better method is applicable.

Duralumin, used in aircraft, is subject to embrittlement due to intercrystalline attack, a type of corrosion. Some people feared that the loss of the Shenandoah was due to weakening from this cause, and advocated abandonment of duralumin aircraft construction. Exhaustive tests of materials from the wreck showed that this fear was unfounded. Nevertheless deterioration from this cause, if it advances far, may be very dangerous and prevention of or protection against such embrittlement must be attained to utilize the full value of this light alloy. Nitrates, as from the salt baths used in heat-treatment are harmless, but chlorides, which may be present, as in sea-air or hydrogen peroxide possibly formed by the action of light, cause rapid attack. On this action accelerated laboratory test methods are based.

Tentative conclusions, that improvement can be made by use of another alloy of the duralumin type, or by adjustment of the composition and heat-treatment, and that complete protection may be afforded by impervious coatings, with varnish, bitumastic enamel, anodic coating in chromic acid solution, or by a metal-sprayed coating of commercially pure, unalloyed aluminum, these increasing in effectiveness in the order given, which conclusions were made on the basis of laboratory tests, are being checked by exposure tests.—H. W. Gillett in *Forging, Stamping, Heat-Treating*, Oct., 1926, p. 368.

Advantages of Purchased Power

Advantages cited for purchased power over power that is privately generated include assurance of power supply during strikes, lower insurance rates, less danger from fires and explosion than when fuel is stored and used for private generation, stability of cost of energy over the instable cost of fuel, greater cleanliness, less noise, free advice from utility experts, quicker repair service, and less attention required on the part of management involving the maintenance of the generating equipment.

Along the lines of investment the list of advantages includes the lower investment in power equipment, the elimination of investment in fuel and equipment for private generation, the elimination of the investment represented by power generating space requirements, and the avoiding of the necessity for disposing of private generating equipment after changes in it are made. The Northern States Power Co., Minneapolis, Minn., has used this list as a basis for selling power to new factory units.—*Electrical World*, Oct. 16, p. 813.

Heat-Treatment Improves Bronzes

Difference in the crystal structure of non-ferrous alloy castings is quite as important as difference in chemical content. Chill-cast bronzes differ materially from sand-cast bronzes. The development of the desired crystal structure by heat-treatment is possible if scientifically handled. The method is essentially the same as for steels but there can be no reliance on color indications. Control must be even closer than with steel. Aluminum bronze is particularly susceptible to heat-treatment. It is possible by this means to increase the ultimate tensile strength about one half, the proportional limit about four times, the yield point about twice and the Brinell hardness number very considerably.—N. K. B. Patch, in *Iron Age*, Sept. 23, 1926, p. 841.

Graphic Checks on Purchasing

A simple form of graphic control of purchasing schedules and deliveries has been used successfully. The factory schedule may not be far ahead of sales, but the purchase schedule should be well ahead of production. Deliveries should be scheduled at least two weeks in advance of the production date. The chart used in scheduling purchases has the number of pieces, or units, plotted against the date of each month. A light line is traced upon the chart showing the schedule requirements for the period covered. A heavy blue line superimposed thereon indicates the purchases that have actually been placed. As the goods are received, a dotted line is plotted showing the relation of receivables to requirements. This second line should be above rather than below the heavy line. A "promise" line can also be plotted. Thus reading across, we might find, as a typical example, that 4,000 pieces were promised Jan. 19, were received Jan. 25, and were scheduled Jan. 28 for use in production. Or reading upward, we might find that on Feb. 1, for instance, 4,500 pieces had been scheduled for total production, 5,600 pieces were on hand, and 6,700 has been promised by that date.—H. D. Murphy, in *Manufacturing Industries*, September, 1926, p. 211.

American Machinist

KENNETH H. CONDIT AND FRED H. COLVIN
Editors

Established 1877

Why Not Lower Corporation Taxes?

THREE hundred millions will probably be the Treasury surplus this year. If so, a continuance of the last increase of the tax on corporation incomes will hardly be justifiable. Lower taxes on business, if they can be brought about, will undoubtedly help to continue present prosperity.

It is therefore the duty of those stockholders who want to see corporation taxes reduced to communicate with their congressmen. The next session of congress will begin on Dec. 4, two days hence.

Express Matter Takes To The Air

AVIATION is gaining ground as a method of commercial transport. Not only is the air mail proving a real service both in speed and in reliability, but more passenger carrying and taxi lines are being established.

Now comes the announcement that the carrying of express matter by air is to be established in the spring. And not by a new concern but by the American Express Co. which plans to contract the actual carrying of the packages to one of the large air transport companies.

In this way a company with long years of experience will attend to the collecting, handling and distributing of the express matter. The actual carrying of the express matter, however, will be handled by a concern specializing in the operation of the planes themselves.

It is not to be expected that all express matter will go by air as it would be an unnecessary expense in many cases. But for packages where time is sufficiently important to warrant the cost, air express has a great future.

In view of the success of the air mail and some of the commercial lines, there can be no question as to the possibilities of air transport when properly managed. We shall look with great interest and expectation to the development of the air express service.

Decent Salaries for Judges

ON DECEMBER 9 the House of Representatives will vote on the bill, already passed by the Senate, to increase the salaries of federal judges. Industry has a stake in this bill because the federal judges have sole jurisdiction of suits for enforcing or annulling patents. A district judge now gets $7,500, a circuit judge, $8,500. The bill increases these amounts to $10,000 and $12,500, respectively. Many good judges have resigned, and others will if the bill fails of passage. You will be doing yourself a service, therefore, if you exert what influence you have on your representative to insure his presence on December 9 and his vote for the Graham Bill, H.R. 10, 554.

How Do We See?

ASK a machinist or a plant executive how this or that mechanical device operates and he generally knows, if he has used it. This knowledge increases the individual's value as a producer. But relatively few persons could answer the same question clearly and concisely if applied to that mechanism—the eye—which is universally used in our work-places. We see entirely by distinguishing differences in brightness and in color. Of these, brightness-difference is of the greatest importance although we depend upon color-difference much more than we ordinarily realize. Increasing the intensity of illumination is favorable to both these factors. The amount of light necessary to distinguish a certain object, brightness-difference, or color-difference, in general increases with the smallness. Shadows play a very important part because they produce a brightness-difference which reveals the object. Backgrounds are very important for the same reason. Light approaching daylight quality is generally best for discriminating small color-differences. Everyone should give more attention to how we see. The lessons and demonstrations are always before our open eyes. More knowledge of this universally used mechanism makes anyone more valuable to himself and to his employer.

How Are Profits?

"HOW Are Profits?" is suggested by Julius Klein as an inquiry to replace "How's Business?" Mr. Klein sees activity too frequently mistaken for prosperity, citing as an example a part of the machinery industry with a turnover of $14,000,000 but a profit of only $130,000, yet whose members felt that business was good.

Volume alone does not necessarily mean good business. As a rule it helps to lower the cost of production, but is likely to raise the cost of distribution. The hum of a busy factory may induce its owner to say business is good when he cannot truthfully say that profits are good.

Have You
a Replacement Policy?

Shop Equipment News

Fox No. 33-HC Heavy-Duty Multiple-Spindle Drilling Machine

The Fox Machine Co., Jackson, Mich., has designed the heavy-duty multiple-spindle drilling machine shown in the accompanying illustrations along the lines of simplicity and rigidity. It features an Oilgear hydraulic feed to the drilling head.

The drive into the machine is at the rear of the column at the base. This drive may be either by means of a friction countershaft or a motor as shown. This motor drive is through the medium of an inclosed silent chain.

The drive is into a gear box located in the base of the column. This gear box is assembled as a unit, but is positively located and held in position on the base of the machine. Alloy heat-treated gears mounted on ball-bearing shafts are used throughout to form a sliding-gear transmission for the selection of one of three speeds for the drill spindles.

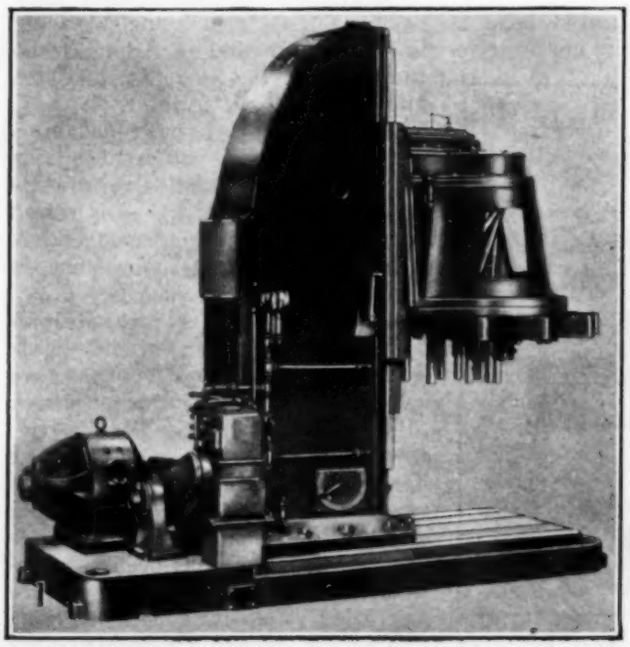
At the front end of the gear box is a set of spiral bevel gears that transmit the drive from the gear box to a vertical double-splined shaft located in a recess in the face of the column and supported by a bearing at the upper end of the column. The drilling head, which moves up and down on the column ways, contains a gear with two keys engaging with the splines in this vertical shaft. Idler gears mounted on ball bearings transmit the motion from this drive shaft and gear to the drive pinions of the drill spindles.

The gears in the gear box in the base of the column continuously run in a bath of oil. The drill head also has its own oil reservoir and a pump within the head so that a continuous flood of oil is provided throughout the head.

The Oilgear pump is driven by an inclosed silent chain from the drive shaft at the rear of the machine. It is capable of producing rapid travel to the head in either direction and a drilling feed that can be adjusted to any desired rate. On the right side of the machine column are placed adjustable stops that regulate the amount of rapid head movement and the depth of drilling feed. A fine adjustment for the drilling depth is provided for use in drilling blind holes.

The manual control for this hydraulic feed is located at the right front side of the drilling head for convenience of the operator. The operation is automatic once the operator sets the lever in position to secure rapid down travel. At a predetermined point, the stops automatically slow down the feed for drilling, and at the completion of the drilling operation the head is automatically rapid traversed back to its original position. At any time during the cycle, however, the operator can use the manual control to stop or reverse the head-piece. Provision is made so that the control handle can be locked in its neutral position to prevent accidents while the spindles, drills, or work are being adjusted.

The drilling head and the saddle are separate units. With this construction it is possible for the saddle to have a long bearing on the column ways so that it amply supports the head under heavy drilling loads. The drilling head can be furnished in a great variety of sizes either round or rectangular. Likewise spindles of any desired size can be furnished. These spindles can be supplied with



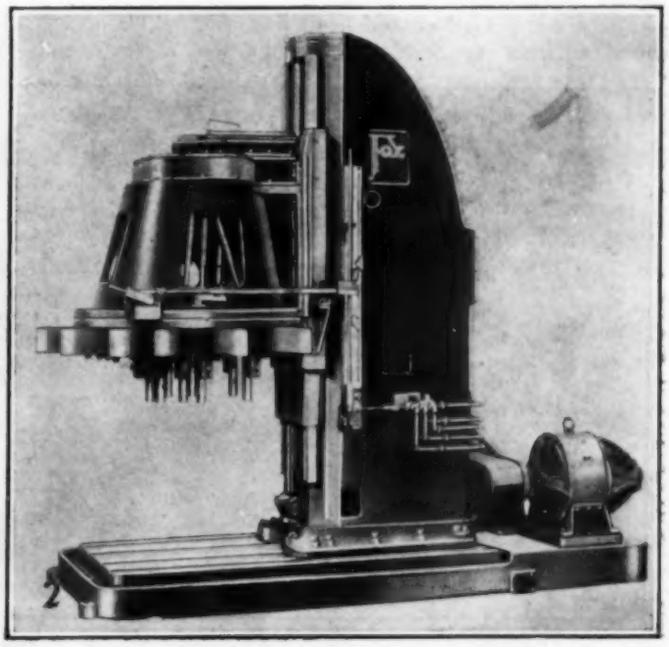


Fig. 1—Fox No. 33-HC Heavy-Duty Multiple-Spindle Drilling Machine. Fig. 2—Front view of machine

Shop Equipment News

individual speed controls, including a neutral position, although for drilling at a high rate, a single spindle speed is much preferred due to the more rigid construction possible.

Located in the column recess directly behind the vertical drive shaft is the hydraulic feed cylinder. It is readily accessible when attention is required by removing the sheet metal covers for the column face below the head. Standard machine construction provides for a feed cylinder having a 12-in. stroke, which is sufficient for most drilling jobs. Provision is made, however, for the mounting of an 18-in. stroke cylinder should occasion require one. The feed pipes supplying oil to the cylinder are inserted through the side of the column with pipe unions so located as to permit easy disconnection when removing a cylinder.

The feed cylinder ram is of special construction and embodies 24-in. of substantial square threads that engage with a nut held against rotation by the head saddle. The upper end of this ram telescopes in a sleeve suspended from the top cover. The ram and the sleeve are keyed together and the sleeve is capable of rotation produced by the operator turning a crank on the left column side. With this construction the head can be adjusted to any desired range on the column for a particular job.

Warner & Swasey Improved No. 4 Universal Turret Lathe

The Warner & Swasey Co., Cleveland, Ohio, has made a number of improvements in its No. 4 universal turret lathe, which was previously described on page 941, Vol. 61, of the *American Machinist*. The bar capacity of the machine is for stock 1½ in. in diam., while the swing over the ways is 16 in. The improved machine is provided with three types of head: A six-speed all-geared head, shown in Fig. 1; a six-speed cone head, shown in Fig. 2, and a twelve-speed all-geared head.

The six-speed all-geared head has been entirely redesigned. Spindle speeds ranging from 45 to 423 r.p.m. are instantly available by means of convenient levers located on the head. Two reverse speeds are also provided. The gears run in oil and the shafts are mounted upon Timken roller bearings. Babbitt lined bearings are used for the spindle proper, however, in conformity with the usual Warner & Swasey design. With this range of speeds, and with the power capacity of the machine, the grouping of multiple cuts is possible.

The six-speed all-geared head is well suited to individual motor drive, and for this purpose a pedestal leg is provided in which the motor can be mounted at the head end of the bed. Both ends of the motor cabinet are hinged so as to make the motor easy of access. Provision is also made for mounting the motor on a vertical plate fastened at the head end of the machine.

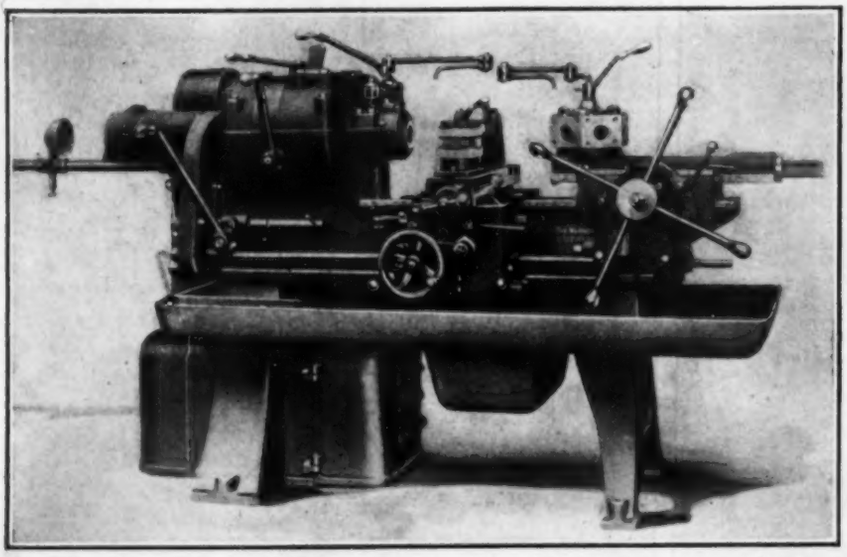


Fig. 1—Warner & Swasey No. 4 Universal Turret Lathe, with six-speed geared head

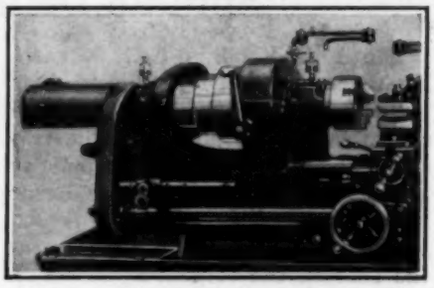


Fig. 2—Six-speed cone head with geared scroll chuck

The six-speed cone head shown in Fig. 2 has also been redesigned. By means of a geared friction drive, six spindle speeds are available with a three-step cone and back gears. An improved type of belt shifter makes it possible to shift the belt from one step of the cone to another quickly. In this machine the back shaft is in a fixed position, so that the gears are always in engagement with the spindle gear, and no eccentric movement is necessary for releasing the back shaft gears. Hence, the entire construction has been made more rigid and the back shaft itself made heavier. The front spindle bearing is 3 in. in diam. and 4½ in. long, while the rear bearing is 2½ in. in diam. and 3¾ in. long.

By running both pulley countershafts forward at different speeds the number of obtainable spindle speeds with this cone type is raised to twelve. With this construction, however, no reverse movement is provided.

The twelve-speed all-geared head remains unchanged. Spindle speeds ranging from 30 to 760 r.p.m. are available and are obtained through sliding gears.

The automatic chuck and the bar feed mechanism shown in Fig. 3 are operated by means of a long lever in front of the head. Effort required to operate the chuck has been substantially reduced by means of a pivoted operating yoke with rollers engaging the wedge in the automatic chuck mechanism. Also, by means of a

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stepped wedge on the spindle and operating fingers provided with rollers, the collet is automatically adjusted for slightly varying diameters.

Power longitudinal feeds either right or left and power cross feeds in either direction are standard in the cross slide carriage, which has been strengthened. The square turret provides four cutter positions in addition to the one in the rear tool post. These cutters may be operated simultaneously with the tools on the hexagon turret. Four independent adjustable stops carried on a stop roll throw out the longitudinal feeds.

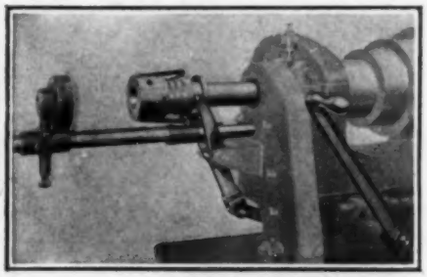


Fig. 3—Automatic chuck bar feed

These feeds are all available from the apron of the carriage itself, so that they may be conveniently changed. In the direction of feed, the cross slide carriage is independent of the turret. A large graduated dial is fitted to the cross slide with adjustable indicators for accurately gaging the depth of cut. The square turret is quickly indexed without lifting it from its seat. It is mounted upon a hardened and ground tapered stud that can be adjusted for wear.

The turret slide and saddle unit are the standard Warner & Swasey type. A supplementary taper base and taper gibs provide for vertical and horizontal adjustments to assure permanent alignment of the spindle and the tools. The turret stud is tapered, so that it also provides adjustment for wear. Six power feeds are obtained through a gear box mounted in front of the saddle. Independent adjustable stops operate for each turret face and may be set to throw out the power feed at any desired point. These feeds are independent of the cross slide carriage feeds.

The No. 4 universal turret lathe is offered as a simple machine, or with standard bar or chucking equipment. The bar equipment will handle a wide variety of work within the cutting range of the machine. It includes the following tools: Flanged tool holder, single-cutter turner, multiple-cutter turner, end-facing tool, center-drilling tool, self-opening die head.

For light work where piloting is unnecessary, or for center piloting on quantity work, the plain set of chucking tools is offered as follows: Multiple-cutter head, flanged boring cutter, multiple turning head, drill holder, vertical slide tool, floating tool holder. A set of chucking equipment with overhead pilots is also offered where additional rigidity is necessary. This set differs from the plain set of chucking equipment in only two tool stations. An overhead piloted multiple turning head is substituted for one multiple-cutter head, and an overhead pilot bar is added to the multiple turning head, which already carries an ear for this purpose.

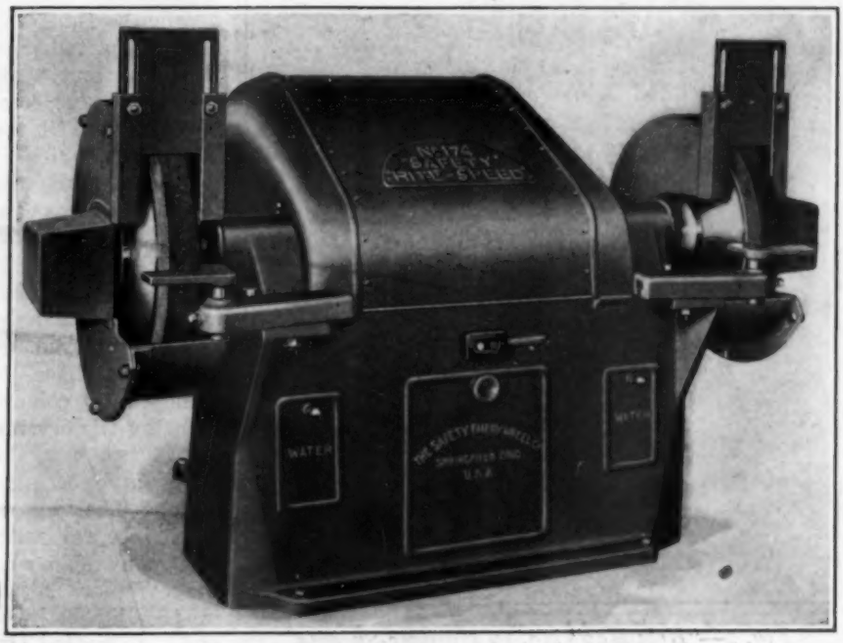
The taper attachment will turn tapers up to a slope of 3 in. to the foot in lengths of 6 in. The operation of the square and hexagon turrets is not affected by the installation of the taper attachment. A screw threading attachment is also available for cutting threads ranging from 4 to 32 pitch. It operates by means of a leader and follower, and a micrometer screw attached to the cross slide provides a fine adjustment for the depth of cut.

"Rite-Speed" Floor Grinder

The Safety Emery Wheel Co., Springfield, Ohio, is marketing the so-called "Rite-Speed" floor grinder shown in the accompanying illustration. The drive of the machine is such that proper operating speeds for grinding wheels can be obtained with different size wheels and with either alternating- or direct-current motors.

The motor is mounted within the machine, and it drives the spindle by means of a silent chain inclosed and running in oil. By changing the sprocket diameters any practical grinding wheel speed can be secured. Either a.c. or d.c. motors can be applied, and in the former case any frequency can be used. In either case, a ball-bearing type motor is furnished.

The grinding wheel spindle is also supported on three double-row, deep-groove ball bearings. Two of the bearings are mounted at either end of the shaft near the grinding wheels, while the third bearing is near the center and shares the chain



"Rite-Speed" Floor Grinder

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pull. The two bearings on either side of the sprocket are mounted in a single housing, while the third bearing is in a separate housing. In order to take up chain wear, the motor is mounted upon a sliding base.

These grinding machines are offered in four sizes to accommodate wheels ranging from 14 to 30 in. in diameter, and for motors ranging from 3 to 15 hp., depending upon the requirements. Automatic starters with push-button control, are also furnished.

"Hole Hog" No. 10 Multiple-Spindle Automatic Lapping Machine

The "Hole Hog" No. 10 multiple-spindle automatic lapping machine shown in the accompanying illustration, Fig. 1, has been developed by the Moline Tool Co., Moline, Ill. The purpose of the machine is to lap or hone automotive cylinders at a minimum cost, and its operation is as nearly automatic as possible. This machine can be furnished with a proper number of spindles and jig for either a 4-, 6- or 8-cylinder block. The illustration shows a 4-cylinder honing machine.

The table of the unit is stationary, and the reciprocation takes place in the rail that carries the hone. The machine can be furnished to give any predetermined number of strokes. It is started by the shifting of a single lever, which causes the lapping tools to rotate and brings them down to the working position, where they are reciprocated a set number of strokes and are then returned to the starting position and stopped. This cycle takes place automatically.

The chief function of the base of the machine is to provide a settling tank or reservoir for the kerosene or compound used as a coolant for the hones. It is divided into a number of compartments holding in all about two barrels of liquid. A pump and piping system keeps a steady flow of the compound on the lapping tools. Two movable drawers located directly under the jig receive the fluid as it leaves the tools. From there it overflows into the first compartment in the base and then into successive compartments until the last, from which it is pumped to the tools. With this construction, most of the grit and dirt is caught in the drawers where it can be readily removed.

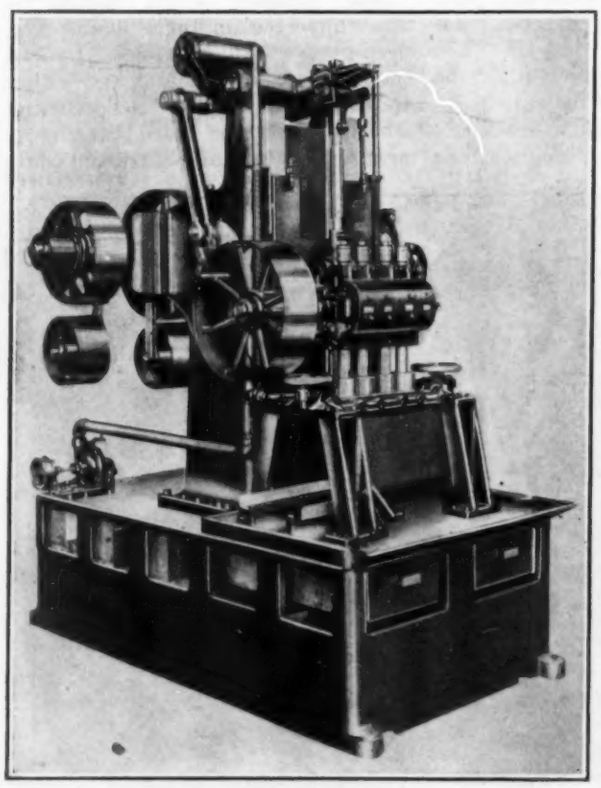

Fig. 1—"Hole Hog" No. 10 Multiple-Spindle Automatic Lapping Machine

On the base is mounted a column carrying the driving mechanism for the hone and a pan table. The jig is built integral with this pan table and the cylinder is put in the jig endwise and is located by disappearing locating pins operated by a lever at one end. The handwheels, shown on top of the jig, are used to clamp the cylinder block in place. On the upper part of the jig are lap-closing or retaining bushings that hold the laps in a closed position and guide them into the cylinder bores.

The drive is either direct from a lineshaft or from a motor mounted on the base to a countershaft on the rear of the machine. From this main driveshaft the power is transmitted by a belt and idler tightener pulley to a shaft that drives the spindles through spiral bevel gears. On the end of the power countershaft can be seen a clutch for controlling the motion of the lapping tools.

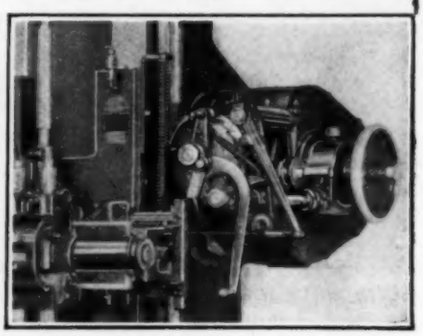

Fig. 2—Reciprocating feed mechanism

The entire head slides up and down in the guides on the face of the column, and in order to make the motion smooth springs are used to support the head. Reciprocating motion is obtained through a balanced rocker arm on top of the column. A connecting rod, driven by means of a special crank mechanism, oscillates this rocker arm. This crank mechanism consists of a drum mounted within the column, on the end of which is carried a crank disk that can be locked so as to either become a unit with the connecting rod or to rotate as a fixed part of the drum. In the first position the normal throw of the crank pin mounted in the drum is obtained, while in the second position the effect is to increase the radius of stroke by an amount equal to the normal offset of the pivot point of the connecting rod from the center of the crank disk. This enlarged throw is brought into play at the end of the operation to withdraw the hones from the cylinders.

The mechanism for accomplish-

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ing this motion is shown in Fig. 2. The lever is used to set the machine in operation. With each reciprocation of the head the ratchet plate shown is advanced one tooth, and with it a disk cam, on the contour of which is a depression. When the cam roller follower drops in this depression, suitable mechanism connected with the follower arm engages the pin in the crank mechanism that results in the enlarged throw. When the hones are withdrawn to their highest position, the machine stops.

The length of the working stroke is adjustable from 4 to 6½ in. The position of the slide can also be adjusted by a right- and left-hand screw bar in the link that connects the rocker arm to the head. All reciprocating parts, such as the rail slide and head, are made of aluminum so as to give a minimum weight of reciprocating parts. The approximate shipping weight of the entire machine is 9,600 pounds.

General Electric Automatic Arc Welder

The General Electric Co., Schenectady, N. Y., has designed the automatic arc welder shown in the accompanying illustration. The welder is to be sold separately or as a part of a complete welding equipment including the necessary clamps and framework for holding the work. Its principal application is for the construction of such standard products as pipes, tanks and boilers, automobile axle housings, and the like where the welding operation is constantly repeated as part of a regular production schedule. The operation is entirely automatic, being started by a push-button control.

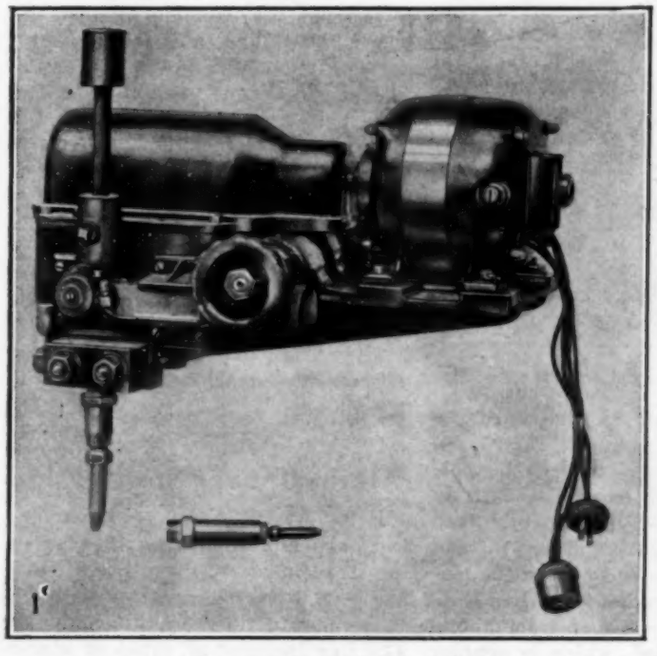
In this welder the arc is started automatically by touching the electrode to the work and then withdrawing it. Thereafter a constant arc length is maintained by feeding the electrode wire to the weld at a predetermined rate of speed necessary to replace the electrode fused into the weld. It is claimed that this apparatus will perform these operations more rapidly and with a greater degree of accuracy than is possible by the most expert hand operators.

The welding head incorporates the necessary mechanism for feeding the electrodes to the arc and consists essentially of a pair of feed rollers geared to a constant-speed motor through a magnetic clutch. The gearing and feed mechanism are contained in a single housing to which the motor is bolted. The distance and pressure between these rollers are readily adjustable. From the feed rollers the welding wire is fed through a nozzle to the arc. Each welding head is equipped with a set of nozzles for 3/32-, 1/8-, 5/32-, 3/16- and 1/4-in. wire.

The speed of wire feed may be adjusted by means of a selective gear changer to suit the size of the wire and the welding current used. Three gear speed changes can be made by moving the gear shift pin, which extends from the rear of the gear housing. An additional finer adjustment can be made by means of a rheostat in the field circuit of the motor.

Provision is made for pointing the electrode backward or forward in the line of weld, and also for moving it sideways. The pointing of the electrode is obtained by rotating the head on its horizontal shaft and the lateral movement by means of the handwheel on the front of the head.

Control equipment consists of a control panel, a meter panel, and a push-button station. The control panel mounts the main-line contactor for the welding circuit and two smaller contactors for interlocking the travel motor with the arc. By means of auxiliary contacts, the line contactor controls the starting and stopping of the feed motor. The magnetic clutch is operated forward or backward by means of a voltage



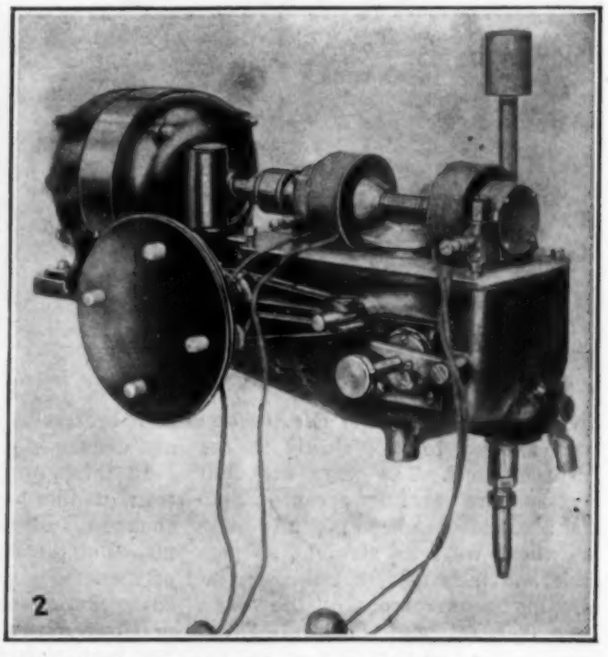


Fig. 1—General Electric Automatic Arc Welder. Fig. 2—Rear view of welder

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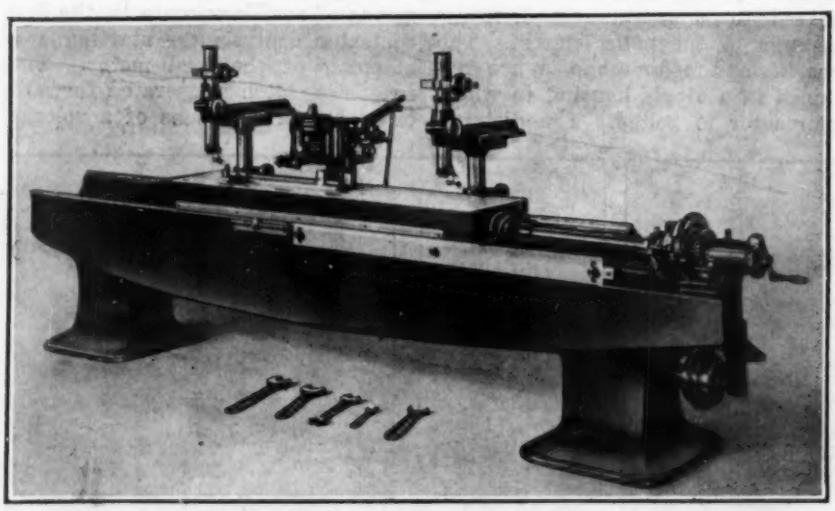
relay, the coil of which is connected across the arc. Thus the electrode is fed to or from the work automatically and adjusts itself to any irregularities in the surface of the work. By means of one rheostat, the speed of the feed motor is controlled and by means of another rheostat the voltage across the arc can be set.

"Société Genevoise" Nos. 0015 and 0016 Linear Dividing Machines

The Société Genevoise D'Instruments de Physiques of Geneva, Switzerland, have developed two models of their precision linear dividing machine, Nos. 0015 and 0016, incorporating considerable changes over former models. This equipment is being marketed in this country by the R. Y. Ferner Co., Investment Bldg., Washington, D. C. Machine No. 0015 is entirely hand-operated, while machine No. 0016 is fully automatic, being driven by a ¼-hp. motor. Both machines have the same capacity for graduating linear scales up to 20 in. in length, and can be used to make rulings on metal, wood, celluloid, or glass. The fully-automatic machine is illustrated.

In order to prevent subsequent warpage, the beds of the machines are heat-treated at 650 deg. C. and then allowed to cool slowly in the furnace itself. The ways are chill cast and are carefully scraped. Special attention has been given to making these ways as straight as possible and it is said that the sum of two maximum errors of the ways, both vertical and horizontal, has been reduced so that it does not exceed 0.0001 inches.

The lead screw has also been specially heat-treated, to increase its hardness and reduce wear. The thread has a profile angle of 30 deg. so as to give a large bearing surface. By the use of a compensating templet, shown at the front of the machine, the error of the screw is reduced to less than 0.0001 in. These templets are similar in principle to those used on other Société Genevoise linear dividing machines, lathes, jig-boring machines, and thread-grinding machines. The total periodic errors of the screw are less than 0.00003 in. The rear thrust bearing of the screw is readily adjustable and the surfaces are hardened and specially lapped to reduce this error to a minimum. The nut of the lead-screw is made of phosphor bronze of considerable hardness and density.



"Société Genevoise" No. 0016 Linear Dividing Machine

In this improved model, the pattern of the bed has been entirely changed and the micrometer head placed at the right-hand end instead of the left, in order to make the machine more convenient for hand operation. A new type of tracing tool has been provided, which is simpler to adjust and more substantial in construction. With this tracing tool it is possible to increase the number of lines that may be ruled by the automatic machine to a range of 10 to 30 per minute, instead of the former range of 6 to 20 per minute. The maximum height of the engraving tool above the table of the machine has been increased from 2 to 3 in., and lighter lines, as well as heavy, may now be ruled, the lines varying in width from 0.002 in. to 0.006 in. With a diamond engraving tool, which is special to the machine, lines as fine as 0.0001 in. in width can be ruled. The maximum length of lines that can be ruled with the machine is 1 inch.

Tracelet disks, with 8, 10, 12, and 16 notches, are provided to permit graduation of the scale to vary the length of the lines on either the binary, decimal, or duodecimal systems. The pitch of the lead screw is 1/20 in. (or 1 mm. in a metric machine) and ratchet wheels having 200 and 160 teeth are provided so that it is possible to rule as many as 4,000 lines per inch, if desired, or to make up verniers of practically any unit desired for the regular rulings obtainable with the machine.

Two micrometer microscopes are furnished with each machine and are mounted on adjustable supports which can be placed at any point of the bed. These serve for checking work that has already been performed on the machine against the screw of the machine or by comparison with another standard scale. They also are of use in case the piece being ruled is longer than the capacity of the machine and re-setting of the work is required after it has been partly graduated.

The table of the machine is 6x27 in., while the space required for the whole machine is 60x16 in. by 22 in. in height. The net weight of the hand-operated machine is approximately 250 lb., and that of the motor-driven machine illustrated is 330 pounds.

Atkins "Silver Steel" Files

E. C. Atkins & Co., Indianapolis, Ind., are manufacturing files under the trademark "Silver Steel" that has been used in connection with the saws manufactured by this company. The line includes all types of standard files for all classes of work.

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Link-Belt Ball-Bearing Vibrating Screen

A ball-bearing vibrating screen adapted to almost any fine screening conditions has been announced by Link-Belt Co., 910 South Michigan Ave., Chicago, Ill. This screen, shown in Fig. 1, is a mechanically operated device and has only one rotating part running in oversize ball bearings.

The vibrator consists of a shaft driven at suitable speed from any common source of power and carrying two adjustable counterweights at both ends overhanging the ball bearings. The bearing construction of this shaft and counterweight can be seen in Fig. 2. Since the bearing box is bolted rigidly to the screen, the vibration induced by the counterweights is transmitted directly to the screen. The screen frame is supported at four points which can be seen in the insert in Fig. 1.

The screen cloth is placed upon the deck of the vibrator with its two longitudinal edges bent up. Binders are provided on a fine mesh cloth for protection against tearing. Two flanged clamp plates engage these binders or the bent edges of the cloth and by tightening the wing nuts on each side, the cloth can be stretched to the desired tension. These side clamp plates serve the

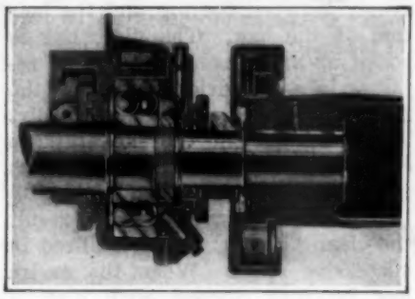


Fig. 2—Cross-section of the vibrator unit

four-fold purpose of stretching the screen cloth, clamping the cloth to its deck, eliminating wear of screen box side frames, and preventing leakage along the side edges. A longitudinal vibrator strip assists the screening action by imparting raps to the cloth, thus minimizing wear and blinding.

A feed hopper attached to the receiving end of the screen box vibrates with it and controls the feed so that the material is uniformly spread over the screening surface. For screening materials containing small particles, the vibrating feed hopper is fitted with a counterweighted swinging feed gate. The use of mechanical distributors is said to be obviated.

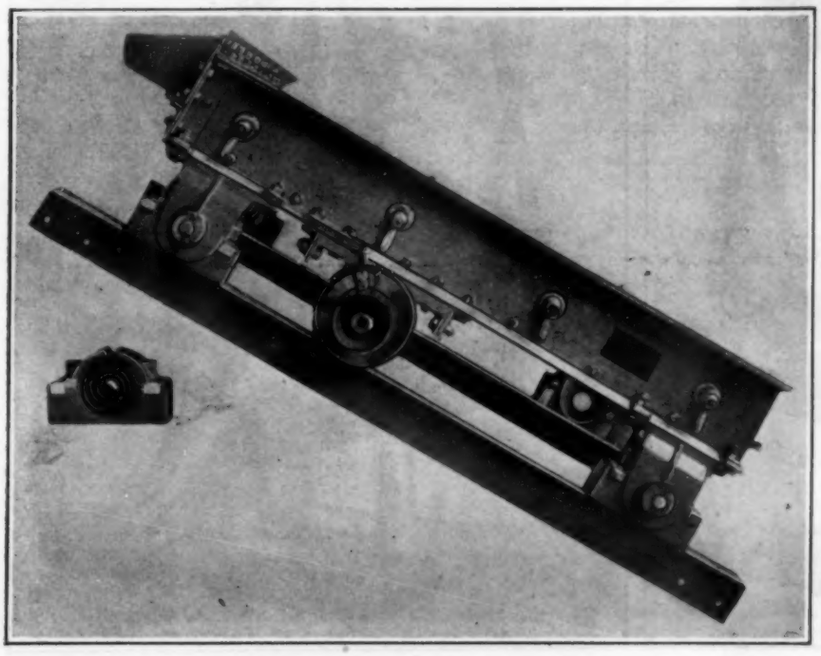
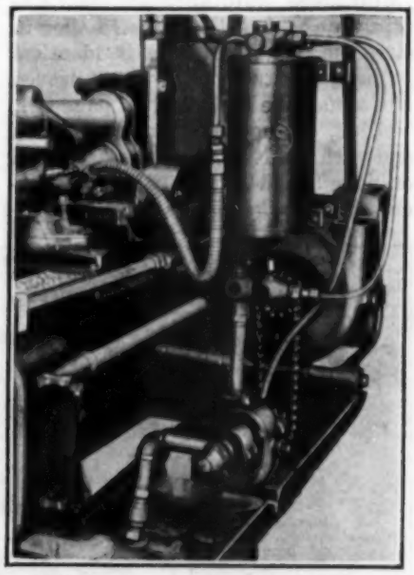


Fig. 1—Link-Belt Ball-Bearing Vibrating Screen

This vibrating screen is made in five standard sizes: 2x5 ft., 3x5 ft., 4x5 ft., 3x8 ft. and 4x8 ft., and each size can be furnished with either one or two screening surfaces, so that a wide range for materials of varying size and capacity is obtained. The screens are of such size that screen cloth coming in standard roll widths can be used.

AC Industrial Oil Filter

The AC Spark Plug Co., Flint, Mich., is marketing the industrial filter shown in the accompanying illustration for eliminating grit and dirt from cutting compounds and coolants. The same filter can also be used for handling lubricating oil for bearings. This filter is said to eliminate poor finish caused by grit and chips in the cutting compound and to prevent grit and chips sticking to chuck jaws thus causing eccentricity. It is also said that by



AC Industrial Oil Filter

using a filtered coolant, grinding wheels, cutters, and tools last longer. Grinding wheels do not have to be dressed as frequently nor does as much material have to be removed at dressings; cutters need not be ground as often, and less stock need be removed from them at each grinding.

This industrial oil filter is practically identical with the filter recently developed for use in connection with automobile engines and by slight modifications in the connections the

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same filter is applicable to machine tools. The same size refill cartridges as for automotive use can be used in these industrial filters. The filtering capacity is made to suit conditions by using banks of several filters connected in multiple. The small size machines require but one filter, however.

As shown in the illustration the filter unit is connected in the high pressure line between the pump drawing the coolant from the sump and the point of distribution at the tools or cutters. The filter proper consists of a bag made of special flannel of fine texture so that very small particles of dirt are filtered from the oil. The bag is wound around a central header or master tube and stitching forms parallel channels so that the oil is distributed evenly between the top and the bottom of the bag. The filter bag is rolled up and placed in a screen retainer in a cylindrical tank. As the filter bag becomes clogged with dirt removed from the oil, the pressure causes the bag to unroll slowly thus presenting a new section of bag to the incoming dirty oil. As a result the clean filtering area is utilized in successive steps. When the entire bag becomes clogged with dirt, a new cartridge consisting of a bag and screen in a tank can be inserted in the unit.

"Milwaukee" No. 2 Milling Machine

The Kearney & Trecker Corporation, Milwaukee, Wis., has added the No. 2 machine shown in the accompanying illustration to its line of "Milwaukee" milling machines. Except for the fact that it is smaller in size, the No. 2 machine is identical in design features with the improved No. 4 machine described on page 881, Vol. 64, of the *American Machinist*, and with the No. 3 machine described on page 341, Vol. 65. This No. 2 machine is available in the plain, universal, and the manufacturing type.

Either belted drive or motor-in-base drive can be furnished at the option of the customer. The same column is used in either case, and there are no changes in the all geared drive. Timken tapered roller bearings are used throughout.

Power rapid traverse in three directions is available at the work on all types, except the manufacturing, which has power feed and rapid traverse in the table only. Self-oiling universal joints are used in all feed and power rapid-traverse shafts. Duplicate front and rear control levers add to the convenience of operation.

As in the larger machines, centralized lubrication supplies the column, knee, and saddle. An automatic low-pressure coolant system is also included on all machines. The cutter coolant pump is removable and easily accessible. Six pockets in the table provide ample coolant return channels.

Black & Decker No. 90 Electric Valve Re-facer

The Black & Decker Manufacturing Co., Towson, Md., is building the No. 90 electric valve re-facer shown in the accompanying illustration. It is a heavy-duty machine with an adjustable work head permitting the re-facing of poppet valves at any required angle. The work head is adjustable from 0 to 90 degrees.

Two individual electric motors are used in the machine; one drives the work head, the other, the grinding wheel. The use of two motors is said to insure steady and abundant power to the grinding wheel and work head respectively, and this construction eliminates many small parts that

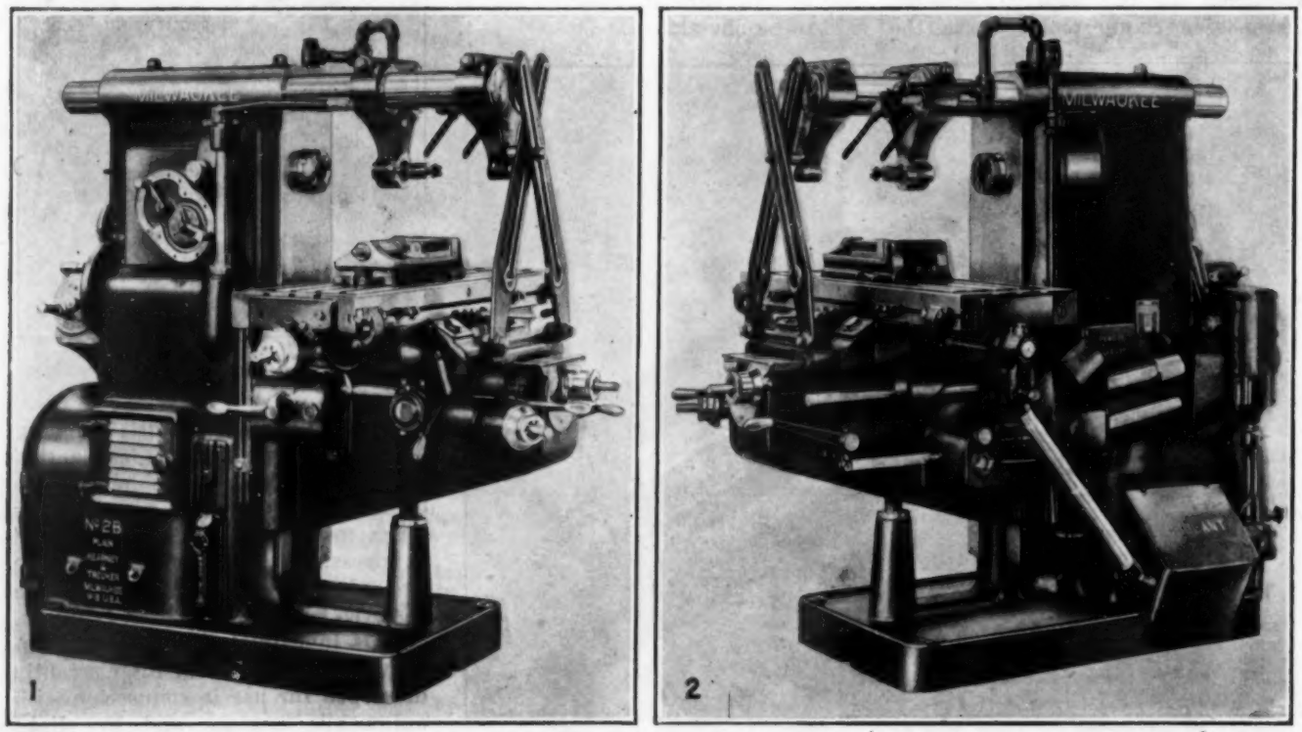

Fig. 1—"Milwaukee" No. 2 Milling Machine. Fig. 2—Rear view of the machine

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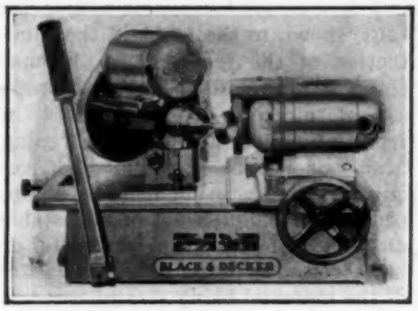


Black & Decker No. 90 Electric Valve Re-facer

would be necessary to transmit power from a single motor. Each motor is provided with an individual switch. Both motors are of the Universal type and operate on direct or alternating current of 25 to 60 cycles.

The work head and the grinding head operate on V-slides, to which they are held by spring clamps. Both heads have three-point suspension. The base also rests on three points so as to eliminate the possibility of the machine teetering.

Gardner No. 79—72-In. Vertical Disk Grinder

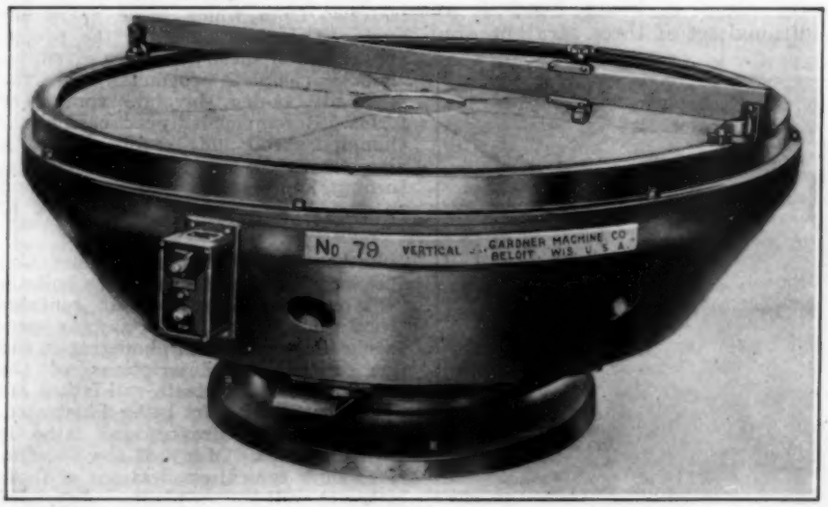
The Gardner Machine Co., Beloit, Wis., has announced the development of a vertical disk grinder for surface operations of especially large area. The machine, No. 79-72 in., is shown in the accompanying illustration.

The machine differs from the standard 72-in. Gardner disk grinder in two main features. The No. 79-72-in. machine is designed for either wet or dry grinding, and it contains a direct-connected vertical motor, which makes a compact, self-contained machine requiring a minimum amount of floor space.

The machine is of massive proportions with a sturdy base casting. It carries a steel disk wheel 72 in. in diameter, traveling in a horizontal plane. This disk wheel is reinforced by a 40-in. steel plate 1 in. in thickness, and is mounted on a heavy supporting wheel collar 29½ in. in diameter. The collar is fitted with a taper fit to the upper end of the rotor shaft. This rotor shaft forms the driving spindle of the machine, and is of crucible steel mounted on radial and thrust ball bearings. All bearings run immersed in oil.

The motor frame serves as the machine pedestal, the base being the motor end plate. The frame is designed for the free circulation of air, the cool air being drawn up through openings in the base by fan blades mounted on the under side of the disk wheel. The push-button control is mounted on any point on the base according to the demands of convenience.

A rigid horizontal-bar dressing device is provided with the machine. A sliding block carries the dresser cutters, and is forced by hand back and forth across the abrasive disk.



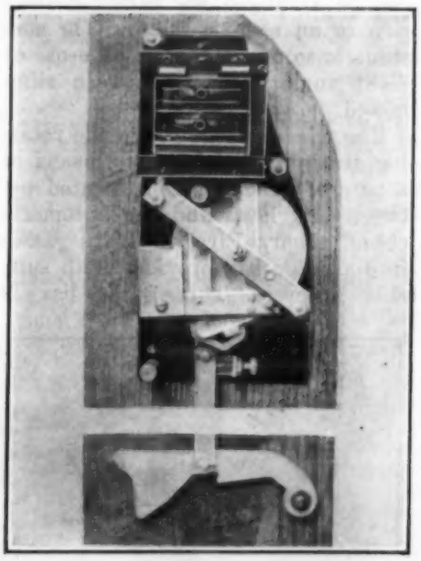
Gardner No. 79—72-in. Vertical Disk Grinder

A special pneumatic press is also furnished with the machine. When the abrasive disk is in position ready to receive pressure for the setting up, the pneumatic press is clamped to the disk wheel, and air is pumped into the cone by means of a pump furnished with the machine. The pressure is equivalent to about 14 tons on the whole surface of the wheel, and is claimed to be sufficient to make a perfect job of the setting-up operation.

The reservoir has a capacity for 75 gallons of cutting compound, and is provided with hand holes for cleaning out the sludge. The floor space occupied by the machine is a circle 7 ft. in diameter, and the weight is about 9,000 lb. The maximum horsepower is 40, and the spindle speed is 375 rev. per minute.

General Electric Time-Delay Attachment for Hand Starting Compensators

The time-delay attachment illustrated has been designed by the General Electric Co., Schenectady, N. Y., for use with hand starting compensators to provide undervolt-



General Electric Time-Delay Attachment for Hand Starting Compensators

age protection during brief disturbances in industrial power circuits. In a plant where a large number of motors is utilized a separate circuit is often used to energize the under-

Shop Equipment News

voltage coils of the starter, this circuit being furnished by a motor-generator running on its own momentum for some time after the failure of power. The time-delay attachment was developed to meet the demand for a time-delay undervoltage release resulting from the large number of potential dips caused by the increased use of such power systems and the wider use of undervoltage protection on motor starters.

The attachment bears the designation CR-2820-1062. It can readily be mounted on a hand starting compensator in the same supporting holes as used for under-voltage release.

Time-delay is accomplished by means of a falling solenoid plunger, the downward movement of which is retarded by means of a flywheel. This flywheel is rotated by means of a pinion on its shaft driven through a rack fastened to the solenoid plunger. On the downward movement of this plunger the flywheel is caused to revolve, but the design is such that on the upward movement of the plunger the teeth of the rack are disengaged from the pinion so that this movement can be accomplished rapidly. The time delay is about 1¼ sec. and if power returns in less than that time the starting compensator is not tripped.

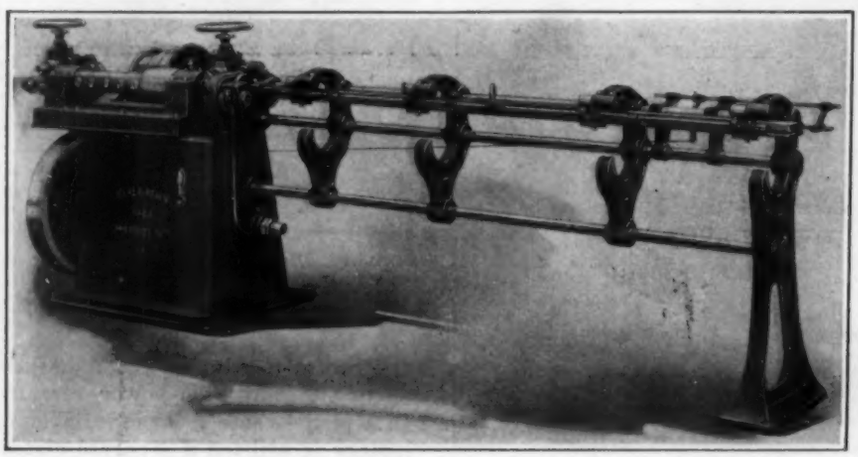
Kane & Roach Automatic Wire Straightener and Cut-off Machine

Kane & Roach, Syracuse, N. Y., have designed the automatic wire straightener and cut-off machine shown in the accompanying illustration. The machine will handle any size wire up to and including wire ⅜ in. in diam. A belted model is shown. When required, the machine can be arranged for direct connection to an electric motor. The machine is so designed that all cross or right angle belting has been eliminated.

The wire is fed through the rotating straightening head by means of a pair of pinching rolls located between this head and the automatic cut-off shear. First the wire passes into a guide bar provided with suitable grooves. This guide bar is equipped with an adjustable stop gage that automatically trips a cam at a fixed point. By means of this cam action, the shears are operated and the material cut to accurate length. In conjunction with this shearing operation, the guide bar automatically opens, thus permitting the wire to drop beneath into the forks. The automatic cut-off shears are equipped with dies corresponding to various wire diameters, so that the wire is given a clean shear. It is not bent nor are there any burrs left on it.

The dumping tables and the automatic cut-off arrangement can be supplied in various lengths. Where heavy stock is being handled, an additional set of three straightening rolls, shown to the right in the illustration of the feed end of the machine, are provided. In addition, a set of pinching rolls mounted in front of the rotating straightening head can also be provided when required. The rotating head is equipped with a complete set of adjustable dies made of gray iron, gun metal or hard iron, depending upon the nature of the material being straightened.

A three-step cone pulley drives the feeding rolls, so that a change of speed is possible. For light and soft work, the feeding rolls can be run at high speed, while for springy or tough material the rolls can be run at a slower delivery speed. The entire equipment is ruggedly constructed and is of compact design. For instance, the balance wheel that drives the automatic cut-off shears is conveniently located under the frame.



Kane & Roach Automatic Wire Straightener and Cut-Off Machine

Trade Catalogs

Gears. William Ganschow Co., 1017 West Washington Blvd., Chicago, Ill. has published a small pamphlet giving a brief history of this concern and its present status. The pamphlet is illustrated.

Gears, Silent. The General Electric Co., Schenectady, N. Y., has published a 28-page, 8½x11-in. catalog on silent gears made of Fabroil and Textolite. This booklet is well illustrated throughout and is perforated for binding in loose-leaf form. In the introduction the place that non-metallic gears occupy in industry is first explained, followed by a brief discussion of the manufacture and characteristics of the material from which these gears are made. Complete data for the proper application of these gears are given, including complete formulas for the modified 14½-deg. involute spur gear forms. Recommended practice for machining Fabroil and Textolite gears is also presented. This includes boring, turning, key seating, tooth cutting, and so on. A large list of stock sizes of Fabroil blanks is appended.

Lathes, Roll. Mesta Machine Co., Pittsburgh, Pa., has issued bulletin "F" on its roll lathes. It contains twenty 7½x10½-in. pages and is profusely illustrated with photographs and line cuts. Brief descriptions of the principal parts of Mesta roll lathes are first given, each part being illustrated. Selection of the proper size lathe is then discussed. Many of the illustrations show typical applications of these lathes in well-known plants. Appended to the bulletin is a table giving cutting speeds for various size rolls.

News of the Week

British Machinery Industry Sees Revival with End of Coal Strike

Machine tool builders busy on special equipment

By Our London Correspondent

At the moment of writing the long-continued mining dispute drags its way along, but the end is fairly well in view. Many of the men still remain obstinate, but the miseries to families involved in industrial disputes are not what they were, the social legislation of the last few years having mitigated them considerably.

A satisfactory conclusion of the dispute does not mean the return of the miners to work. The price at which coal can be supplied is vitally important to the metal trades. Coal and coke are being imported from abroad, but at uneconomic prices. In some English areas plenty of coal is being mined, but the price of this is such that manufacturing operations cannot be conducted at a profit. The heavy cost of coke and pig iron is raising the cost of castings and, as the result, tool makers are discussing the feasibility of increased prices for their products. The state of the market would hardly warrant an attempt to raise prices generally.

Shortage of Steel

A report on any branch of the metal industry indicates the scarcity of materials. Recent references to shipbuilding have suggested something like stagnation as the result of the shortage of steel, and the locomotive building industry has had to restrict operations. In shipbuilding orders have recently been placed, and speaking of engineering generally, it is known that a considerable number of projects have been postponed. Consequently it is not unreasonable to expect a fairly busy time as soon as the mining trouble has ended.

In the circumstances, the machine tool branch of engineering can hardly complain. There has of late been very little change in conditions, and machine tool firms continue to fill some of the gaps by means of contract work on special machinery. A recent call on half a dozen firms found them engaged not only on their own special products, but also on such work as slate-cutting machinery, special rolls, box-making machinery, special welding machines, wire-working machines, and special internal combustion engines, while machinery for the motor car industry has long been a stand-by for more than one machine tool firm. The export trade in machine tools seems to be fairly satisfactory.

Not until some time next year will data be available regarding the last census of production. The ratio of home and export trade cannot, therefore, be stated definitely. But the British Engineers' Association reports that in 1923 and 1924 the proportions of the home and export engineering trade were about 73.5 per cent and 26.5 per cent respectively, that is about three to one, the proportions when the ast census of production was taken, namely in 1907, being 46.65 per cent and 53.35 per cent, or about equal. It is admitted that the financial position would be worse "but for the expansion of the home market, which must be attributed in the main to reconstructive work following on the war; the lavish expenditure of money on utility services; railway electrification; and the great increase in the home demand for motor vehicles of all kinds."

The report states that in 1925, 133,500 motor cars were produced in Great Britain, together with 40,199 commercial vehicles. Regarding the use of oil fuel, it is stated that at the end of September last for marine purposes some 271 oil engines, with an aggregate of 781,870 shaft horsepower, were under construction throughout the world, plus 254 steam engines and turbines of 764,026 shaft horsepower. Both in numbers and power therefore the oil engine has beaten the steam engine. Of the total, 53 oil engines of 275,530 horsepower and 135 steam engines and turbines of 392,661 horsepower were being built in Great Britain and northern Ireland. Thus, while this country is holding its own in the construction of steam machinery for marine engineering, a greater number of oil engines are being built abroad. But, as units, the oil engines built here seem to be bigger than the average.

Loree Puts Faith in Steam Locomotive

The steam locomotive, and not electricity, will continue to be the dominant factor in the development of modern railroad transportation, stated L. F. Loree, president of the Delaware & Hudson Co., at the fall meeting of the Holland Society of New York, held on Nov. 23 at the Hotel Astor. Mr. Loree received the 1926 medal of the society. This medal is awarded annually to the person who, in the estimation of the society, has done most to promote the welfare of mankind in his own particular field.

"The substitution of electric haulage for steam railway transportation is widely urged," said Mr. Loree. "While this contest may be expected to continue long in the future, perhaps usurping and stabilizing itself in restricted fields, the dominance in its larger aspect will depend largely upon the ability, genius, courage and tenacity of the exponents of one or the other method of transportation. For myself, I have an abiding faith that for the main purpose of the railroad—the transportation over long distances of heavy articles—the unit system of transportation (steam locomotive) will be the dominant one."

Complete Organization of Power Transmission Association

The second general meeting of the organization committee of the Power Transmission Association was held on Nov. 17, at the Pennsylvania Hotel, New, York, with representatives present from a large number of leading manufacturers of mechanical power transmission and allied equipment. W. H. Fisher, chairman of the committee, presided and after the meeting had been called to order introduced Frazer M. Moffat, president of the Tanners Council of America, and E. J. Mehren, vice-president of the McGraw-Hill Publishing Co., Inc., who spoke briefly on the ideals and purposes of trade associations and their value in promoting closer co-operation in the solution of problems that are of mutual interest.

Chairman Fisher then presented the report of the organization committee, in which it was shown that to date 104 companies had signified their intention of joining.

After some discussion it was unanimously voted to put the association on a permanent basis and have it undertake active work at once. The following officers were elected: President, W. H. Fisher, secretary and sales manager, T. B. Wood's Sons Co.; vice-presidents representing,—Leather Belting Manufacturers—F. H. Willard, president, Graton & Knight Manufacturing Co.; Tanners and Curriers—Edward D. McKown, vice-president, Hans Rees' Sons Co.; Power Transmission Equipment Manufacturers— Geo. H. Miller, president, Dodge Manufacturing Corporation; Pulley Manufacturers—Wm. R. Simpson, vice-president, the American Pulley Co.; Hanger Manufacturers—S. A. Ellicson, president, Chicago Pulley and Shafting Co.; Accessory Manufacturers — Wylie K. Lee, president, Clipper Belt Lacer Co.; Fabric-base Belt Manufacturers—B. J. Kielly, president and general manager, R. & J. Dick Co.; treasurer, L. H. Shingle, president, Shingle-Gibb Leather Co.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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IMPRESSIONISTIC art has been defined as nature seen through the eyes of temperament, and the same thing might be said of most of the business forecasts issued recently. Our views of the future are always somewhat affected by our self-interest and our preconceptions, but the economic situation is so nicely balanced at present that the personal equation is likely to be unusually influential in its interpretation.

No one can deny the prosperity of the United States; but everyone is agreed that it cannot last indefinitely and there are many who seem to feel that for one reason or another a turn in the tide is at hand.

Even the Thanksgiving Day editorials and sermons reflected this feeling, and the celebrated preacher, Dr. Fosdick, voiced it when he said "Some nations have been ruined by poverty. But the list is short and sweet compared with a list of those peoples that were ruined by success. As nearly as it can be figured America holds one third of the world's wealth. In addition, if the debts are to be handled as now planned a large part of all the people of Europe for sixty years to come will be paying all their surplus earnings into our pockets.

"What the possession of all this excessive prosperity is doing to our mental and moral stability seems plain. There are thirty murders a day in the United States now. The national government lately ordered 3,000 armored motor cars to transport our mail, not through an enemy country, but through our own domain. Even outside of the boundaries of banditry search among our people for the old ideals of self discipline and self denial. Where will you find them? Something has gone deeply wrong with the moral fiber of the nation."

Dr. Fosdick is quoted at length because his words explain the readiness of philosophic observers to stress the economic developments that are inauspicious and minimize those that are auspicious. The theory is that lacking self restraint we will soon be restrained by the compulsion of events and anything that sustains this theory is emphasized whether it be relevant or not. Hence the prominence given to a few unfavorable items in last week's statistical record. They include:

A slight decline in bank clearings as compared with 1925. Gross earnings that were a little less than last year on a few important railroads.

Some reduction in car loadings. A lessened demand for steel. A report from the Department of Commerce that put the October production of passenger cars at 288,842 and that of trucks at 42,490 as compared with 394,056 and 44,323 respectively in the same month a year ago.

What's Doing in Industry

The taking of annual inventories and the natural suspension of high-production industrial activity at this time of the year are reflected in the slowing up of sales in the machinery and machine tool industry. The market is characterized by the absence of large orders for shop equipment and most current business is being done in small tools and single machines purchased here and there to replace obsolete equipment or bolster up some particular phase of production that is expected to begin immediately after the first of the new year.

Detroit is quiet but there is a good volume of business pending from the automotive and electric refrigeration industries. The volume is holding up well in Chicago and the list of inquiries gives great promise for the early months of 1927. Small orders make a satisfactory volume in Cincinnati and the outlook is bright. Railroad car shops and farm implement manufacturers are placing some orders in the Indianapolis district.

The gradual but extensive expansion of steel and construction enterprises in Canada has had an encouraging effect on machine tool business and prospects are good for a substantial sales volume next year. Inquiries have picked up in New York and fair business is expected for the balance of the year. A slight recession is apparent in the New England territory but this is seasonal and probably only temporary.

In the general business world only a few unfavorable factors are discernible, but the abundance of credit provides business with a shock absorber that should make even the roughest roads smooth.

A government estimate which probably defers the hope of an advance in cotton because it indicates a crop of 18,399,000 bales, and a lengthy dispatch from Chicago published in the *New York Times* in which it is asserted that the "business tide in the Middle West is ebbing."

But it is an old maxim that the expected rarely happens and the very promptness with which these developments have been recognized may enable us to avert the depression of which they are supposed to be the harbingers. At all events they include about the only unfavorable factors that are discernible, and the abundance of credit provides business with a shock absorber that will make even the roughest roads smooth.

Stock speculation is not, however, as active as it was, and the same feeling of caution that prevails in commercial circles is to be observed among the brokers and their clients. The securities of some of the sugar companies have advanced sharply on the improvement in the price of raw sugar, and the shares of the Baldwin Locomotive Co. have moved sensationally for reasons that are known only to a few.

Current estimates are that the world's wheat crop will be 200,000,000 bu. in excess of the demand, and grain prices have been easier although they rally whenever the market becomes oversold. The fact is that bears are restrained by the fear that short sellers will be held up to public execration by the Congressional farm bloc.

It is, indeed, probable that the problem of agricultural relief will monopolize the attention of the Congress when it convenes in December, and it promises to become a political issue of the first magnitude. The advance in sugar that has followed President Machado's action in limiting the Cuban crop and the further advance that seems to impend have led to a suggestion that agricultural production in this country might be controlled by an acreage tax that would be increased when prices are low and reduced as they advance. The underlying principle is not new, as the supply of four staples, rubber, tea, coffee and sugar, is now arbitrarily restricted by growers' agreements or governmental edict, but the American farmer would probably oppose a direct tax on production.

Retailers report that Christmas shopping has already commenced, with the result that the gifts purchased will be more useful than formerly, but some think that the effect will be to reduce the post-Christmas trade in essentials. Such forehandedness in borrowing trouble is, however, unnecessary as a good business until well after the New Year seems to be assured.

The Industrial Review

Progress of the machinery and machine tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

Detroit

Such change as there has been during the past week in the machinery and machine tool field in Detroit and other automotive centers of southeastern Michigan has been a further falling off in sales. Only a few plants are buying new equipment and in most instances these purchases have been fairly well determined in advance. Inquiries are falling off in accordance with the seasonal slump in sales and it is likely to be the first of the year before the activity shows any improvement.

While automobile plants are not buying except where necessity demands, the electrical refrigeration industry is having what one might call a phenomenal growth. It is known among machine tool dealers that several manufacturers in Detroit are contemplating the addition of iceless refrigeration machines to their lines. The new plants of the Nizer and the Kelvinator organizations will mean the expenditure of hundreds of thousands of dollars for new machinery. Some of this is being ordered now. Other equipment is still in the blueprint stage.

Packard, Continental, Cadillac, Kelsey, Wheeland and Studebaker are buying some tools and machines. Not an order is being given by the Ford Motor Co. except to stop all buying. When things break at Ford's machinery manufacturers will be deluged with business, machine tool men believe.

New York

A few last-minute orders placed so as to become of record in the 1926 financial report, served to bolster up what might have been a very poor month in November. The outlook for December sales is doubtful, for this month is usually slow. But this year has been rather peculiar in many of its trends and some dealers in this market are looking for good business before the first of the year.

Inquiries have picked up but whether the equipment mentioned in these will be purchased before January first is doubtful as most appropriations for machinery have been used up by now.

The total business for last week was encouraging. More than one fair sized order was recorded and some high-priced machines were included. Purchasers included the Westinghouse Electric and Manufacturing Co., the Driver-Harris Co., General Electric Co., the Lehigh Valley R.R. and one or two other large corporations. Machines purchased by these companies were of the replacement character.

The used tool market is slow, buyers not taking too easily to price concessions in current offerings.

Indianapolis

Machine tool and machinery business here is holding its own with every prospect of increase in volume as soon as the various industrials pass over the inventory period at the end of the year. November volume shows at least a 10 per cent increase over the business done during the same month last year. The volume of inquiries, particularly for special machinery for various industrials, is particularly good, leading the trade to believe that a very good business will follow the close of the year.

Perhaps the best business being done now is machinery for coal mines. Several mines in the Indiana district are being re-conditioned and put in operation; many have been idle for months and much new machinery and equipment is necessary before they can get into production.

A good demand continues to come from the farm implement factories, both for tools and special equipment. This demand is expected to hold steady during the most of the winter. Railroad buying in Indiana is being cut down materially and the same is true of other public utilities. However, demand from the car shops both for tools and machinery is far better than it was this time last year. Virtually every car shop in this section is working to capacity in an effort to re-install in service rolling stock for handling the enormous volume of coal.

The automobile demand has decreased slightly during the last two weeks. This is seasonal and a much brisker trade is expected by the end of the year.

A considerable volume of business comes from the furniture and automobile body manufacturers, most of it for special woodworking machinery. Machine shops locally are very busy and this is reflected in the rather active machine tool demand from this source.

Canada

Taking everything into consideration, the outlook for the machinery and machine tool business in Canada is exceedingly bright. Reports from the principal industrial centers are of an optimistic nature and indicate a general expansion of business. A notable feature is the general renewal of industrial activity in the Maritime provinces. One of the best signs of this is the fact that so many industries in that section of the Dominion are now working full time. The Dominion Iron and Steel Co. now has 2,800 men employed. This company has just completed a 25,000-ton rail order for the C. P. R. and will immediately commence rolling a 32,000-ton order for the Canadian National Ry. The directors of the James W. Cumming plant at New Glasgow report that operations for the fiscal year just closed have shown an increase of over $100,000 in sales and that there are sufficient orders in sight to assure steady work for the remainder of the year.

The agricultural implement industry is operating on heavy production schedules. At the Brantford plant of the Massey-Harris Co. there are 1,100 men employed and both day and night shifts are required to keep up with the work. The Steel Co. of Canada is operating on a full and steady schedule. It is reported that the volume of business of the Canadian General Electric Co. is running about 30 per cent ahead of last year.

Hardware dealers are buying in large quantities, anticipating a bigger and better fall and Christmas trade, and as each week passes, reports from every section of the Dominion indicate that there is further good cause for optimism.

Chicago

During the last week there was little change in the condition of the machine tool market. Reports from manufacturers' representatives are to the effect that business is holding up well, and that the volume of November's trade will compare favorably with that of October. From information gleaned from several sources, the indications are that there is no reason to fear any sharp buying decline for the present. Inquiries coming in augur favorably for satisfactory conditions to prevail, at least until the close of 1926.

In certain lines of manufacture, local representatives of Eastern concerns express considerable optimism with respect to the prospects for 1927. The demand for sensitive drills, which has been excellent throughout the present year, is reported by one Chicago agent to have been unprecedented during the last few months, the demand in November for the product of his company having been greater than in any single month since 1918.

Used machinery dealers report a fair business, which, if maintained at its present level for the remainder of this year, will round out a satisfactory twelve month's business, all things considered. None of the lists reported as having been in the hands of the trade for several weeks has as yet been closed, but announcement from purchasing agents with respect to definite closing is confidently looked for shortly. Railroad business, as for some time past, is without feature.

Cincinnati

Machine tool manufacturers and selling agents of the Cincinnati district report a fine volume of sales in the past week, showing an increase. Several manufacturers report that orders now booked will take all of their production until after the first of the year, and the number of inquiries coming in are taken as a clear indication that the peak has not been reached.

While no one industry did a great amount of buying in the past week, practically all classes of machine tool users made some purchases, and as a result the sales of that period were well diversified as to sizes and types. It is stated that the N. & W. Railroad will close a good-sized order in the next week or ten days. Concerns in the automotive industries made a few purchases, these being confined to single tools and replacements, but an increased volume of business is expected to come from this field soon.

Taking the machine tool plants as a whole, the daily production was slightly increased. Manufacturing conditions are favorable in every way, but there is no surplus of skilled labor.

New England

Buying of machinery and machine products in the New England territory shows only a slight indication of slowing up, and whatever appears is attributed to the fact that 1926 has less than a month to go and December purchases ordinarily undergo a decline. The buying is representative of general lines of industry and the decline, such as appears, is largely in the automotive field. Salesmen working out of Hartford find a disposition to postpone buying until after the end of the year.

Credit men are engaged in a year-end clean-up of outstanding accounts and generally speaking responses are good and the financial statements should show substantial improvement in this respect. The financial statements are being studied carefully and the opinions of executive officials is that they will be the most satisfactory of any recent year. Financial positions have been substantially improved and instances where red ink appears are the exception.

Would Simplify Cylindrical Roller Bearings

A representative group of manufacturers of cylindrical roller bearings convened at the Department of Commerce on Nov. 17, under the auspices of the National Committee on Metals Utilization, for the purpose of considering the feasibility of applying the principles of simplified practice to their product.

As presiding officer, Edwin W. Ely outlined the procedure that is followed by the National Committee on Metals Utilization in its co-operation with business to eliminate prevalent, avoidable waste; gave examples of successful consummated simplified practice programs; explained the advantage of providing a transitional period during which eliminated varieties may be cleared without infringement upon the effective date of the recommendation and indicated the willingness of the committee to refer any tentative program which might eventually be proposed to a joint conference of all interests in any way concerned with the fabrication, sale, or use of the commodity under review for its consideration, modification and voluntary adoption.

The conference after having given its attention to the results that have been attained in other fields confined the discussion to the subject of cylindrical roller bearings, what the scope of the initial step in simplification should be, and the best method of expediting such a step.

It was the sense of the meeting that the initial step should be confined to an effort to eliminate the excessive variety of bore sizes up to 6 in. of cylindrical roller bearings, i.e., bearings exclusive of that type which are now interchangeable with ball bearings, and which conform with present ball bearing standards.

The conferees were further of the opinion that a survey of current practice and existing over diversification would prove of practical value to all concerned. Such a survey would make possible the drafting of a tentative recommendation, based upon the major demand, which could be modified and constructively revised by a general conference of all interests at a subsequent date.

Rail Equipment Men Meet in New York

The Railway Business Association, a national body of manufacturers of railway equipment, material and supplies, held its anual meeting on Nov. 18 at the Hotel Commodore, New York.

Resolutions were adopted urging that in the establishing of transportation rate levels the strengthening of the market for railway stock be kept in view; opposing all measures which would tend to impair the independence of the Interstate Commerce Commission; opposing regional appointment of Interstate Commerce Commissioners; opposing legislative rate-making, including bills for repeal of the Pullman surcharge; favoring retention by the commission of its discretion to grant relief from the long-and-short-haul section, and favoring exclusion of coercive features from any legislation in furtherance of railway unifications.

Reasonable governmental regulation of motor vehicles in the interest of the public was recommended with a view to restricting automobile common carriers and other motor vehicles in so far as it should be necessary to preserve use of the highways for other traffic for which they were built, with fair liability for expenses of road repairs.

Inequality between the normal income tax rate of 5 per cent affecting individuals and partnerships and that of 13½ per cent affecting corporations was charged, and it was recommended that the tax rate for corporations be reduced.

"The Supply Industry and Future Railway Progress" was the subject of a discussion in which addresses were made by Roy V. Wright, A. H. Mulliken, A. C. Moore and S. O. Dunn.

Four new vice-presidents were elected: W. L. Conwell, New York; George A. Martin, Cleveland; M. G. Truman, Chicago, and Harry Scullin, St. Louis. Officers re-elected were vice-presidents Samuel B. Hastings, of Chicago, B. L. Winchell, of New York and Herbert I. Lord of Detroit; the president, A. B. Johnson, of Philadelphia, and the treasurer, P. Harvey Middleton of Philadelphia.

Mark Flather Dead

Mark Flather, president of the Grover File Co., of Nashua, N. H., and one of the pioneers in the machine tool industry in this country, died at his home in Nashua on Nov. 25. He was 75 years old. Mr. Flather was actively engaged in the manufacture of machinery from 1885 to 1912 and during that time perfected many mechanical inventions and designs that have been adopted in the construction of standard machines. He contributed many ideas to the development of planers, shapers and lathes. He also designed and manufactured machinery for the furniture industry and later for the electrical trade.

Engineering Courses Need Renovation

American engineering colleges must renovate their methods, it was declared in a report of the board of investigation and co-ordination of the Society for the Promotion of Engineering Education, made public in Washington on Nov. 18, at a meeting of the deans and administrative officers of 164 engineering institutions of the United States and Canada.

The board, of which Professor Charles F. Scott, of Yale University, is chairman, presented the results of a three-year fact-finding investigation just completed in this country and Europe. It urged that a program of sweeping reforms be put into effect at once in all the engineering colleges of the country, concurrently with joint activities of the Society for the Promotion of Engineering Education, the great national engineering societies, the industries, the secondary schools and the non-engineering colleges.

Machinery Will Feature Power Exposition

The Fifth National Exposition of Power and Mechanical Engineering which will be held in the Grand Central Palace, New York, from Dec. 6 to 11, is expected to be an all inclusive exhibition of all types of mechanical equipment. This exposition will occupy four floors of the palace and give opportunity for nearly 500 manufacturers to display their products. It is estimated that 100,000 engineers and industrial executives will visit the show.

Power generating apparatus and accessories will, of course, furnish the main attraction to visitors. The tremendous advances in the development of means of transforming coal and oil into heat and power insure a large number of novel exhibits which will attract the attention of many visitors. But there will also be numerous novel exhibits in the displays of refrigeration apparatus, of heating and ventilating equipment, of material handling devices, of mechanical power transmission machinery, of machine tools and of the many other classes of machinery upon which modern industry depends.

Must Qualify for Ordnance Courses

In a news item that appeared in the issue of Sept. 30, it was stated that correspondence courses instituted by the War Department were open to "civilians interested in national defense preparation."

We are now informed by the Ordnance Department that these courses are open to students, either service personnel or civilians, who enroll in the basic course of the branch in which they are interested. They must study these sub-courses in sequence, unless their experience qualifies them in the subject matter covered by the sub-courses. Corps Area commanders are responsible for this selection and approval.

Business Items

The Link-Belt Co., of Chicago, has established a branch office in New Haven, Conn., in charge of R. H. Hagner.

The Kirby-McCool-Cyphers Co., machine tool dealer, of Newark, N. J., has changed its name to the Kirby-McCool Co.

The Union Screw and Manufacturing Co., of Pittsburgh, has moved into a new factory at 207 South Main St. New equipment, electrically driven, has been installed and production of screw machine products, cap- and set-screws, and milled nuts, is proceeding on schedule.

The Hart & Cooley Co., of New Britain, Conn., manufacturer of sheet-metal products has approved the suggestion of the directors to separate the stockholdings from manufacturing operations and organize a new company to be known as the Hart & Cooley Manufacturing Co.

Receiver for the Davis-Warner Fire Arms Corporation, of Norwich, Conn., has been authorized by the Superior Court to arrange for the sale of the equipment and property of the company. No date has been set. The company has been in the hands of a receiver since August.

The Triplex Machine Tool Co., of 50 Church St., New York, announces that it will exhibit the Geneva-Swiss jig boring machine at the National Exposition of Power and Mechanical Engineering, in New York, Dec. 6 to 11. This will be the first appearance of this foreign machine in the East.

The Botfield Refractories Co., of Philadelphia, announces the appointment of the following distributors of Adamant fire brick cement: The Curtis Supply Co., of Buffalo; the Waldreth Supply Co., of Des Moines, Iowa; the South Side Foundry and Machine Works, of Charleston, W. Va.; the Empire Machinery and Supply Co., of Norfolk, Va.

The Gray Telephone Pay Station Co., of Hartford, Conn., at a recent meeting of the directors authorized the incorporation of the Long Security Lock Co., as a subsidiary. Officers will be practically the same as those of the Gray company with George A. Long, inventor of the security lock, as president. The product is to be a lock for commercial uses on safe deposit vaults, cash registers and security boxes. About 1,000 a day will be manufactured with work starting in January.

Obituaries

THOMAS H. MIRKIL, JR., Philadelphia district manager for the Treadwell Engineering Co., died on Nov. 12.

CHARLES K. H. BUNTING, of Walter B. Snow and Staff, Inc., technical advertising experts, of Boston, died suddenly on Nov. 14.

JOHN M. BROWNING, noted firearms inventor, died in Liege, Belgium, on Nov. 25. Mr. Browning had gone to that country to supervise the manufacture of a new type of gun which he had recently perfected.

JAMES W. JONES, formerly instructor in machine work at the Massachusetts Reformatory, and noted as the inventor of the reversible screw driver, died on Nov. 6, at his home in Concord Junction, Mass.

DOUGLAS H. THOMSON, of Farmington, Conn., was killed in an automobile accident near his home on Nov. 20. Mr. Thomson was president of the Terry Steam Turbine Co., of Hartford.

ANDREW WHEELER, former president of Morris, Wheeler & Co., manufacturers of iron and steel, and also president of the American Iron and Steel Association, died at his home in Philadelphia on Nov. 24.

WILLIAM LARIMER JONES, president of the Jones & Laughlin Steel Corporation, died at his home in Pittsburgh on Nov. 25. Mr. Jones had been associated with the steel industry for many years, having succeeded his father in the management and control of the Jones & Laughlin organization

Personals

WALTER D. BRIGGS has returned to the sales force at the Syracuse office of Crane-Schiefer-Owens, Inc., of Buffalo.

ROY D. KERBY has been appointed general manager of Durant Motors, Ltd., of Canada.

ARTHUR JACKSON, of the Arthur Jackson Machine Tool Co., Toronto, Canada, will sail from New York on Dec. 22 for Bermuda.

CHARLES H. LEA, treasurer of the Fenton Machine Tool and Die Co, of Fenton, Mich., has disposed of his interest in that company.

L. F. BERRY has been appointed representative in the new Jackson, Mich., branch office of the Allis-Chalmers Manufacturing Co.

MAJOR R. W. SCHROEDER, superintendent of the Ford Airport at Dearborn, has resigned. He has been succeeded by E. G. Hamilton, Ford pilot and chief tester for the Stout plane division.

B. WICKES, formerly chief engineer for the Wilamette Iron and Steel Works, has been appointed manager of tractor sales for the Loggers' and Contractors' Machinery Co., of Portland, Ore.

HAROLD D. MITCHELL has been appointed sales representative in western New York for the William Ganschow Co., of Chicago. He will be located at 1534 Fillmore Ave., Buffalo. Mr. Mitchell has recently been chief engineer for the Sumet Corporation.

ANSON W. RICHARDS is now associated with the Simmons Machine Tool Corporation, of Albany, N. Y. He was formerly connected with Manning, Maxwell & Moore, Henry Prentiss and with Vandyck-Churchill Co.

HON. CHARLES NAGEL, of St. Louis, former secretary of the U. S. Department of Commerce and Labor, has accepted the chairmanship of the Business Men's Commission on Agriculture, which will make a study of the agricultural situation in the United States.

MEFFORD R. RUNYON has been appointed New York office manager for the Bridgeport Brass Co., of Bridgeport, Conn. Mr. Runyon has been district sales manager in New York and has had a long and varied experience in the brass, copper and bronze industry.

F. ROYAL GAMMON has been appointed manager of the New York factory branch of the Chicago Belting Co., of Chicago. Mr. Gammon comes to this position from the Bethlehem Steel Co., where he was assistant manager of the semi-finished and wire departments. He was at one time vice-president and general manager of the Frank Mossberg Co., of Attleboro, Mass.

Calendar of Local Meetings

Society of Automotive Engineers

Washington Section. Dec. 9. Hotel Hamilton. "Cost of Motor Coach Operation in Washington," by Edward Pardoe.

Indiana Section. Dec. 9. Hotel Severin, Indianapolis. "Advantages of All-Steel Body," by E. J. Baisley. "Advantages of Fabric Body," by H. Steinbrugge.

Southern California Section. Dec. 10. City Club, Los Angeles. "Latest Developments in Aeronautics," by D. W. Douglas.

Chicago Section. Dec. 14. Western Society of Engineers headquarters. Discussion on Motor Coaches.

Pennsylvania Section. Dec. 14. At Kugler's, Philadelphia. "What Is Going On in Philadelphia,"—open discussion led by prominent members.

Metropolitan Section. Dec. 16. Hotel Woodstock, New York City. "Maintenance, Operation and Service," by Col. John Stilwell.

American Society of Mechanical Engineers

Tulsa, Okla. Dec. 9 and 10. Corrosion Conference on Oil Field Equipment, Mayo Hotel. Meeting under the direction of H. B. Bernard, chairman of Mid-Continent Section, A.S.M.E.

Knoxville, Tenn. Dec. 13. "Marble Machinery and Its Handling," by John V. Pierce.

Cleveland, Ohio. Dec. 16. Carnegie Hall. Presentation of a paper—"Blooming Mill Practice," by G. A. V. Russell, of England.

National Association of Cost Accountants

Boston Chapter. Dec. 16. "Plans for the Taking of Physical Inventories," by Stanley G. H. Fitch.

Buffalo Chapter. Dec. 16. "Inventories," by Lewis D. Crusoe.

Cleveland Chapter. Dec. 15. "The Budget as a Business Compass," and discussion of Question Box topics.

Detroit Chapter. Dec. 16. "Hidden Costs in Industry," by C. A. Hoskins.

Erie Chapter. Dec. 20. Budgetary Control and Predetermined Standard Cost.

Hartford Chapter. Dec. 21. "Visualizing Costs," by Carl F. Dietz.

Hawaii Chapter. Dec. 28. "Process of Starch Extraction from Canna Root," by W. L. Doty.

Kansas City Chapter. Dec. 20. How to Read a Balance Sheet and Operating Statement.

Los Angeles Chapter. Dec. 21. Department Store Accounting and Special Christmas Stunts.

Milwaukee Chapter. Dec. 16. "Standard Costs: Scrap and Special Materials," by W. B. Castenholz.

Philadelphia Chapter. Dec. 17. Inventory Control for Manufacturing Industries.

Pittsburgh Chapter. Dec. 15. Joint meeting with Pennsylvania Institute of C. P. A.'s Speaker: A. L. Ashley.

Providence Chapter. Dec. 13. "Inventories," by W. G. Roelker, W. C. Lane and H. E. Howell.

St. Louis Chapter. Dec. 21. "Costs in the Milling Industry," by W. C. Bechert.

Rochester Chapter. Dec. 15. "The Balance Sheet," by David C. Barry.

San Francisco Chapter. Dec. 27. Preparation for Inventory.

Springfield Chapter. Dec. 15. "Federal Income Taxes on Corporations," by R. E. Bagley.

Syracuse Chapter. Dec. 21. "The Use of Ratios in the Analysis of Financial Statements," by M. Wall.

Twin Cities Chapter. Dec. 21. "How Advertising Reduces Costs," by Mac Martin and W. W. Wright.

Utica Chapter. Dec. 13. "The Use of Balance Sheets and Operating Statements," by C. O. Wellington.

Forthcoming Meetings

American Society of Mechanical Engineers. Annual meeting, New York City, Dec. 6 to 9. Calvin Rice, secretary, 29 West 39th St., New York.

National Exposition of Power and Mechanical Engineering. Fifth event, Grand Central Palace, New York City, Dec. 6 to 11. I. E. Moultrop, chairman advisory committee, Edison Electric Illuminating Co., Boston, Mass.

American Association for the Advancement of Science. Annual meeting University of Pennsylvania, Philadelphia, Pa., Dec. 27 to Jan. 1. Sam Woodley, executive assistant, Smithsonian Institution, Washington, D. C.

American Engineering Council. Annual meeting, Hotel Mayflower, Washington, D. C., Jan. 13 to 15. A. C. Oliphant, assistant secretary, 26 Jackson Place, Washington, D. C.

Society of Automotive Engineers. Annual meeting, Detroit, Jan. 25 to Jan. 28. W. Delchamps, chairman, meetings and sections department, 29 West 39th St., New York.

The Weekly Price Guide

Rise and Fall of the Market

Fuel prices dropped 50 to 75c. per ton during the week with the result that pig-iron continued dull in the New York market. Birmingham quotations, however, show considerable firmness. Finished steel remains unaffected by the recent flurry in fuel and iron and shows fairly active demand in railway material and building steel. Tin plates and steel sheets hold firmly to present quotations, while lessened buying without actual drop in prices is evident in steel bars and automotive material. Steel plates are still $1.90, with shapes and bars at $2 per 100 lb., Pittsburgh mill.

(All prices as of Nov. 26)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$24.19
Northern Basic	20.89
Southern Ohio No. 2	21.39
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	26.37
BIRMINGHAM	
No. 2 Foundry	20.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	23.76
Virginia No. 2	28.19
Basic	21.26
CHICAGO	
No. 2 Foundry local	21.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	24.55
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	20.76
Basic	20.26
Bessemer	21.26

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	5.00@5.25
Cleveland	5.00@5.25
Cincinnati	5.00@5.50
New York	5.25@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	Chicago	Cleveland	New York
No. 10	2.40	3.50	3.25	3.89
No. 12	2.45	3.55	3.30	3.94
No. 14	2.50	3.60	3.35	3.99
No. 16	2.60	3.70	3.45	4.09
Black				
Nos. 18 to 20	2.90	3.75	3.60	4.15
No. 22	3.05	3.90	3.75	4.30
No. 24	3.10	3.95	3.80	4.35
No. 26	3.20	4.05	3.90	4.45
No. 28	3.35	4.20	4.05	4.60
Galvanized				
No. 10	3.25	4.10	3.95	4.40
Nos. 12 to 14	3.35	4.20	4.05	4.50
No. 16	3.45	4.30	4.15	4.60
No. 18	3.60	4.45	4.30	4.75
No. 20	3.75	4.60	4.45	4.90
No. 22	3.80	4.65	4.50	4.95
No. 24	3.95	4.80	4.65	5.10
No. 26	4.20	5.05	4.90	5.35
No. 28	4.45	5.30	5.15	5.60

WELDED STEEL PIPE—Warehouse discounts are as follows

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv
1 to 3 in. steel butt welded.	53%	39%	55½%	43½%	54%	41%
2½ to 6 in. steel lap welded.	48%	35%	53½%	40½%	51%	38%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameter in Inches — External	Diameter in Inches — Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at warehouse in lots of less than 100 ft.:

Thickness — Decimal	B.W.G. and Fractions	Outside Diameter in Inches — ⅛	¼	⅜	½	1	1¼	1½
		Price per Foot						
.035″	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049″	18	.17	.18	.19	.20	.21	.23	.25
.065″	16	.19	.20	.21	.22	.23	.25	.27
.083″	14	.20	.22	.23	.24	.25	.27	.29
.095″	13	.21	.23	.25	.26	.27	.29	.31
.109″	12	.22	.24	.26	.27	.28	.30	.32
.120″ or .125″	11	.23	.25	.27	.28	.29	.31	.33
.134″	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Spring steel (light) (base)*	7.00	6.00@7.50	4.65†
Spring steel (heavier)	4.00	....	4.00
Coppered Bessemer rods (base)	6.05	6.00	6.20
Hoop steel	4.49	3.65	4.15
Cold rolled strip steel	6.25	6.35	6.25
Floor plates	5.25	5.30	5.00
Cold drawn shafting or screw	4.00	3.90	3.60
Cold drawn flats, squares	4.50	4.40	4.10
Structural shapes (base)	3.34	3.10	3.10
Soft steel bars (base)	3.24	3.00	3.00
Soft steel bar shapes (base)	3.24	3.00	3.00
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.20	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	60%	55%	50%

Electric welding wire, New York, 3/32, 8.35c.; ⅛, 7.85c.; 5/32 to ½, 7.35c. per lb. *Flat, 1/16@¼-in. thick. †F.o.b. cars.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			15.00
Tin, 5-ton lots, New York			73.50
Lead (up to carlots) E. St. Louis	7.85	New York	8.62½
Zinc (up to carlots) E. St. Louis	7.20	New York	8.25

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot.	15.50	18.00	15.00
Copper sheets, base	22.50	22.00	22.50
Copper wire, base	19.50	19.25	16.12½
Copper bars, base	22.12½	21.87½	22.12½
Copper tubing, base	24.50	24.25	24.50
Brass sheets, base	18.87½	18.62½	18.87½
Brass tubing, base	23.75	23.50	23.25
Brass rods, base	16.62½	16.37½	16.62½
Brass wire, base	19.37½	18.87½	19.37½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1 to 15 ton lots	27.00	27.00	27.02
Zinc sheets (casks)	13.25	13.05	12.01
Solder (½ and ½), (case lots)	43.00	44.50	38½@42½

Babbitt metal, delivered, New York, cents per lb.:

Genuine, highest grade	91.00
Commercial genuine, intermediate grade	64.00
Anti-friction metal, general service	32.50
No. 4 babbitt (f.o.b.)	14.00

Nickel, f.o.b. refinery, cents per lb.:

Ingots	35.00	Electrolytic	39.00
Shot			36.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	35.00
Blocks	32.00	Cold drawn rods (base)	43.00
Cold rolled sheets (base)	50.00	Hot rolled sheets (base)	42.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	12.00 @12.25	11.00	11.00@11.50
Copper, heavy, and wire	11.00 @11.75	11.25	10.25@10.75
Copper, light, and bottoms	9.75 @10.25	9.50	9.25@ 9.75
Heavy lead	6.50 @ 7.00	6.50	6.50@ 7.00
Tea lead	4.50 @ 4.75	4.50	5.50@ 6.00
Brass, heavy, yellow	7.00 @ 7.50	7.25	6.75@ 7.25
Brass, heavy, red	9.25 @ 9.75	9.25	9.00@ 9.50
Brass, light	5.50 @ 6.00	6.00	6.00@ 6.50
No. 1 yellow rod turnings	7.75 @ 8.25	7.50	7.50@ 8.00
Zinc	4.25 @ 4.75	4.00	3.75@ 4.25

TIN PLATES—American Charcoal—Bright—Per box

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$12.10	$11.95	$11.50
"A" Grade:				
IC,	14x20	9.70	9.90	9.50
Coke Plates—Primes—Per box				
100-lb.,	14x20	6.45	6.10	7.00
Terne Plates—Small lots, 8-lb. Coating—Per box				
IC,	14x20	7.75@8.00	6.00	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.13@0.17½	$0.18	$0.15@0.20
Cotton waste, colored, per lb.	.10@ .14	.13½	.12@.17
Wiping cloths, washed white, per lb	.17½	36.00 per M	15
Sal soda, per 100 lb. keg	2.05	2.75	2.75*
Roll sulphur, per 100 lb	2.70†	3.50	4.25‡
Linseed oil, per 7½-lb. gal., 5 bbl. lots	.86½	.98	84
Lard cutting oil, 25% lard, per gal.	.55	.50	48
Machine lubricant, medium-bodied (55 gal. metal bbl.), per gal.	.35	35	29
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40–5%	40–5%	40–5%
Heavy grade	30–10%	30–10%	30–10%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	50%
Second grade	50–10%	60–5%	50–10%

*Per 175 lb. keg. †In 150-lb. bags. ‡Per 425 lb. barrel.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.04	.04	.0415
Brass rods	per lb.	.1662½	.1687½	.1737½
Solder (½ and ½)	per lb.	.43	.425	.40
Cotton waste	per lb.	.13@17½	.13@.17½	15@22
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	7.00
Emery disks, cloth, No. 1, 6 in. dia.	per 100	3.10	3.10	3.55
Lard cutting oil	per gal.	.55	.55	.55
Machine oil	per gal.	.35	.35	.35
Belting, leather, medium	off list	40–5%	40–5%	40%
Machine bolts, up to 1x30 in.	off list	40%	40%	40%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.40	$5.84	$5.13
Emery paper	10.71	11.00	10.71
Emery cloth	27.84	31.12	27.84
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.32	1.45	1.32
Cloth	3.10	3.50	3.05
Fire clay, per 100 lb. bag		.75	.75
Coke, prompt furnace, per net ton	Connellsville,		4.50@4.75
Coke, prompt foundry, per net ton	Connellsville,		5.00@6.00
White lead, dry or in oil,	100 lb. kegs	New York,	15.25
Red lead, dry,	100 lb. kegs	New York,	15.25
Red lead, in oil,	100 lb. kegs	New York,	16.75

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1½ and 1½x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{7}{16}$in., $2.25 per 100, less 40%.

Tap bolts, 1½x½-in., $1.00 per 100. List plus 35% at New York warehouses.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ¼x½-in., 2c. each. Discount 70% for $\frac{3}{16}$-in and smaller and 65% for ¼-in. and larger.
Case hardened ¼x½-in., 6c. each, less 50%.

Rivets, button heads, ¾-in., ½-in., 1-in. diam. x2$\frac{1}{16}$-in. to 4½-in $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, $\frac{7}{16}$x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1½ to 2-in. long, all diameters, 25c.; ¾-in. dia., 35c.; ½-in. dia., 75c.; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb. 50c.; countersunk heads, 45c.

Washers, cast iron, ½-in., $7.00* per 100 lb. at New York warehouses; ¾-in., $6.00* per 100 lb

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Ark., Sheridan—G. W. Williams & Son—4 planing machines, etc. for 1 story, 70 x 80 ft. mill destroyed by fire.

Mass., Dorchester (Boston P. O.)—W. McDonough, Pleasant and Hancock Sts.—miscellaneous tools and equipment for proposed repair and service garage. Estimated cost $60,000.

Mass., Somerville (Boston P. O.)—Cambridge Machine & Tool Co., 234 Washington St.—tools and equipment for machine shop on Medford St.

Mass., South Boston (Boston P. O.)—K. De Pietro, 424 Hanover St., Boston—miscellaneous tools and equipment for proposed repair and service garage, here. Estimated cost $80,000.

Mich., Detroit—Cartwright Die & Tool Co., 2962 Hart Ave.—additional tools and euipment for shop.

Mich., Detroit—Sand Lime Products Co., Jean Ave.—one 30 to 50 ton pneumatic hydraulic press.

Mich., Detroit—F. Seidel, 411 West Holleywood Ave.—one thread cutting bench lathe.

Mich., Detroit—Super Arc Welding Co., 17 East Bethune St.—(automobile repair)—arc welding equipment.

Mo., Kansas City—The Gleaner Mfg. Co., Independence—foundry and machine shop equipment including dies, lathes, etc., for proposed new plant here.

O., Ashland—Firestone Foundry & Mfg. Co., J. H. Firestone, Pres. and Mgr.—tools and equipment including drill press, lathes, grinders, etc. for new shop.

O., Cleveland—W. Gent, Blackstone Bldg. (vending machines)—experimental lathe, 12 to 14 in. swing, 3 to 6 ft. bed, quick change gear also bench drill and filing machine.

O., Cleveland—The McDonald Mfg. Co. (railroad tickets)—small Bliss or Consolidated punch press.

O., Springfield—Daniel Plow Co., E. H. Daniel, Mgr. (motor plows) — complete equipment for plant.

O., Springfield—Fuller's Heat Treating Plant Inc., 19 West Washington St., G. Fuller, Mgr. (general machine work)—machine tools of various kinds.

Pa., Donora—American Steel & Wire Co.—several cranes for plant.

Wis., Waukesha—Butler Bin Co.—multiple punch for 3/16 in. and heavier.

Que., Montreal — Montreal Armature Works Ltd., 31 St. Alexander St., S. T. Sweetman, Mgr.—machinery and equipment for new plant on Shannon St.

Que., Montreal—Pepin & Therrien, 1894 St. Timothee St.—complete tools and equipment for proposed garage and repair shop.

Australia, Melbourne—Victorian Government Railways, will receive bids until Jan. 12 for one plain milling machine with equipment.

Opportunities for Future Business

Calif., Emeryville—Associated Oil Co., Associated Oil Bldg., San Francisco, is having plans prepared for the construction of 1 story auto building shops for building truck bodies and steel tanks at 59th and Green Sts. Estimated cost $100,000. Private plans.

Calif., Emeryville—Magnavox Co., 2725 East 14th St., Oakland, manufacturers of loud speakers, plans the construction of a factory at Park Ave. and Horton and Holden Sts. here. Estimated cost $200,000.

Calif., Emeryville—New Metal Products Co., 59th and Doyle Sts., manufacturers of underground oil and gas storage tanks, range boilers, etc., plans extension to shops. Estimated cost $40,000.

Calif., Fresno—Madary's Planing Mill, H. and Santa Clara Sts., plans to rebuild planing mill recently destroyed by fire. Estimated cost including equipment $300,000.

Calif., Oakland—City will soon award contract for the construction of shops, etc. at Ninth and Fallon Sts. Noted Nov. 18.

Calif., Richmond—Atchinson, Topeka & Santa Fe Ry., 80 East Jackson Blvd., Chicago, Ill., awarded contract for the construction of shops, store houses, etc., here. Estimated cost $30,000.

Calif., San Diego—Bureau of Yards & Docks, Navy Dept., Washington, D. C., plans the construction of storage and shop buildings at Naval Operating Base (Destroyer Base) here.

Calif., San Francisco—Bowie Switch Co., Wells Fargo Bldg., awarded contract for the construction of a 2 story machine shop at 19th and Tennessee Sts. Estimated cost $17,255. Noted Nov. 25.

Calif., San Francisco—City plans an election to vote $60,000 bonds for the construction of a garage and machine shop, also $250,000 bonds for repair shops. M. M. O'Shaughnessy, City Engr.

Calif., San Francisco — Pacific Electric Mfg. Co., 5815 Third St., had plans prepared for the construction of a 1 story, 50 x 100 ft. factory and shops at Carroll and Jennings Aves. G. Wiemeyer, 57 Post St., Archt.

Conn., Stamford—Young & Hartwright, Elm St., awarded contract for the construction of a 2 story, 40 x 80 ft. machine shop at Elm Ct. Estimated cost $40,000.

Ill., Chicago—Peerless Ice Machine Co., 503 South Jefferson St., will build a 1 and 2 story, 125 x 400 ft. factory at 35th St. and Parnell Ave.

Ill., Rockford—Central Iron Works, 421 Chestnut St., has work under way on the construction of a 1 story, 60 x 112 ft. factory. Estimated cost $20,000.

Ind., South Bend—Ditsch Sales & Garage Co., 223 West Washington St., is receiving bids for the construction of a garage and machine shop. Estimated cost $50,000. Austin & Shambleau, 111 North Lafayette St., Archts.

Mass., Beverly—B. Paolillo, 112 Rantoul St., is having revised plans prepared for the construction of a 1 story repair and service garage at 113 Rantoul St. Estimated cost $50,000. W. H. Hunt & Son, 197 Washington St., Salem, Archts.

Mass., Boston—Pierce Arrow Co., 896 Commonwealth Ave., will have revised plans prepared for the construction of a 3 story, 100 x 300 ft. garage, sales and service station at Commonwealth Ave. and Alcorn St. Estimated cost $400,000. H. C. Cook, 408 Pearl St., Buffalo, N. Y., Archt. Former bids rejected. Noted Nov. 18.

Mass., Brookline (Boston P. O.)—H. G. Bunnell, 56 Winchester St., plans the construction of a garage. Estimated cost $175,000. Architect not selected.

Mass., Dorchester (Boston P. O.)—Sullivan Bros., 195 Bowdoin St., plans the construction of a 1 story repair and service garage at Topliff and Bowdoin Sts. Estimated cost $40,000.

Mass., Everett (Boston P. O.)—L. Erickson Electric Co., 6 Portland St., Boston, manufacturers of electrical appliances, awarded contract for the construction of a plant on Terminal St. Estimated cost $40,000. Noted Nov. 18.

Mass., Natick—Natick Box & Board Co., North Main St., awarded contract for the construction of a 1 story addition to mill.

Mass., South Weymouth (Boston P. O.)—Bracket & Margeson, is having plans prepared for the construction of a 1 story repair and service garage on Independent Sq. Estimated cost $40,000. Batty, Gallagher & Hobart, 13 Temple St., Quincy, Archts.

Mich., Muskegon—Panyard Machine & Mfg. Co., Western Ave., will soon award contract for the construction of a 1 story, 120 x 192 ft. and 2 story, 32 x 120 ft. piston ring factory on Getty St. Estimated cost $40,000. Vanderwest & Child, Montgomery Blk., Archts. Noted Nov. 11.

Mo., St. Louis—Chevrolet Motor Co., subsidiary of General Motors Corp., General Motors Bldg., Detroit, Mich., awarded contract for the construction of a 1 story, 161 x 322 ft. parts and service building for automobile plant at Natural Bridge and Union Blvd. here. A. Kahn Inc., Marquette Bldg., Detroit, Mich., Archt.

N. J., Camden—Bridge Plaza Parking Garage Co., c/o Ballinger Co., 12th and Chestnut Sts., Philadelphia, Pa., Archts., awarded contract for the construction of a 5 story garage at 7th and Linden Sts. here. Noted May 6.

N. J., Dunellen—R. Hoe & Co., 504 Grand St., New York, N. Y., awarded contract for the construction of a 1 story, 75 x 100 ft. machine shop, here. Estimated cost $40,000.

O., East Cleveland (Cleveland P. O.)—L. Abrams, Mid-Arcade Bldg., Cleveland, is having preliminary plans prepared for the construction of a 2 story sales and service station at Euclid Ave. and Ford Dr. here. Estimated cost $150,000. J. F. Steffens, Fidelity Mortgage Bldg., Archt.

O., Euclid—The Cleveland Trencher Co., St. Clair Ave., awarded contract for the construction of a 1 story, 59 x 60 ft. factory. Estimated cost $40,000.

O., Youngstown — Valley Iron & Mould Co., J. E. Perry, Pres., will soon receive bids for the construction of a 66 x 1100 ft. plant here. Estimated cost $500,000.

Pa., Altoona — Altoona School District, W. F. Eberle, Pres., 6th Ave. and 15th St., is having plans prepared for the construction of a 3 story, 200 x 220 ft. high school including manual training and vocational shops, etc., on 6th Ave. Estimated cost $700,000. F. E. Hersh & F. J. Shollard, Commerce Bldg., Archts. Frank Irving Cooper, Inc., 172 Irem St., Boston, Mass., Assoc., Archts. Noted Sept. 16.

Pa., Philadelphia—Gulf Refining Co., 1515 Locust St., will build a 2 story 60 x 60 ft. shop and storage building at Penrose St. and Gallows Lane. Private plans.

R. I., Cranston—Grinnell Co. Inc., 260 West Exchange St., Providence, awarded contract for the construction of a 2 story valve manufacturing building here. Estimated cost $50,000.

Tenn., Chattanooga—U. S. Cast Iron & Foundry Co., 27th and Boyce Sts., plans the construction of a foundry. Estimated cost $300,000.

Tex., Childress—Ft. Worth & Denver City Ry. Co., Denver, Colo., had plans prepared for improvements to paint, coach and mill shops here. Estimated cost $100,000. R. C. Gowdy, Ch. Engr.

Wash., Black Diamond — Pacific Coast Coal Co., L-C. Smith Bldg., Seattle, plans the construction of an office and warehouse, shops, etc., here. W. Aitken, Lyon Bldg., Seattle, Archt.

Ont., St. Thomas—Pere Marquette Ry. Co., Fort St. Union Depot, Detroit, Mich., plans the construction of a woodworking plant here. Estimated cost $125,000. H. C. Cassel, Ch. Engr.

Ont., Toronto—Parker Fountain Pen Co., 350 Sorauren Ave., plans the construction of a factory. Estimated cost $300,000. Architect not selected.